EPA/ROD/R08-00/149
2000

EPA Superfund
Record of Decision:

CALIFORNIA GULCH
EPA ID: COD980717938
OU 08
LEADVILLE, CO
09/29/2000

RECORD OF DECISION

LOWER CALIFORNIA GULCH
OPERABLE UNIT 8
CALIFORNIA GULCH SUPERFUND SITE
LEADVILLE, COLORADO

September 2000

U.S. Environmental Protection Agency
999 18th Street, Suite 500
Denver, Colorado 80202

RECORD OF DECISION

LOWER CALIFORNIA GULCH OPERABLE UNIT 8
CALIFORNIA GULCH SUPERFUND SITE
LEADVILLE, COLORADO

The U.S. Environmental Protection Agency (EPA), with the concurrence of the Colorado Department of Public Health and Environment (CDPHE), presents this Record of Decision (ROD) for the Lower California Gulch Operable Unit (OU) 8 of the California Gulch Superfund Site in Leadville, Colorado. The ROD is based on the Administrative Record for Lower California Gulch (OU8), including the Remedial Investigation/Feasibility Study (RI/FS), the Proposed Plan, the public comments received, and EPA responses. The ROD presents a brief summary of the RI/FS, actual and potential risks to human health and the environment, and the Selected Remedy. EPA followed the Comprehensive Environmental Response, Compensation, and Liability Act, as amended, the National Contingency Plan (NCP), and EPA guidance (EPA, 1999) in preparation of the ROD. The three purposes of the ROD are to:

1. Certify that the remedy selection process was carried out in accordance with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act, 42 U.S.C. 9601 *et seq*., as amended by the Superfund Amendments and Reauthorization Act (collectively, CERCLA), and, to the extent practicable, the NCP;

2. Outline the engineering components and remediation requirements of the Selected Remedy; and

3. Provide the public with a consolidated source of information about the history, characteristics, and risk posed by the conditions of Lower California Gulch (OU8), as well as a summary of the cleanup alternatives considered, their evaluation, the rationale behind the Selected Remedy, and the agencies' consideration of, and responses to, the comments received.

The ROD is organized into three distinct sections:

1. The **Declaration** section functions as an abstract and data certification sheet for the key information contained in the ROD and is the section of the ROD signed by the EPA Regional Administrator.

2. The **Decision Summary** section provides an overview of the OU8 characteristics, the alternatives evaluated, and the analysis of those options. The Decision Summary also identifies the Selected Remedy and explains how the remedy fulfills statutory and regulatory requirements; and

3. The **Responsiveness Summary** section addresses public comments received on the Proposed Plan, the RI/FS, and other information in the Administrative Record.

DECLARATION

DECLARATION

SITE NAME AND LOCATION

Lower California Gulch, Operable Unit 8
California Gulch Superfund Site
Leadville, Colorado
CERCLIS # COD980717938

STATEMENT OF BASIS AND PURPOSE

This decision document presents the Selected Remedies for Lower California Gulch (Operable Unit [OU] 8) within the California Gulch Superfund Site ("the Site") in Leadville, Colorado. The Environmental Protection Agency (EPA), with the concurrence of Colorado Department Public Health and Environment (CDPHE), selected the remedy in accordance with Comprehensive Environmental Response, Compensation, and Liability Act, 42 U.S.C. 9601 *et seq*., as amended by the Superfund Amendments and Reauthorization Act (collectively, CERCLA), and to the extent practicable, the National Contingency Plan (NCP).

This decision is based on the Administrative Record for Lower California Gulch (OU8) within the California Gulch Superfund Site. The Administrative Record (on microfilm) and copies of key documents are available for review at the Lake County Public Library, located at 1115 Harrison Avenue in Leadville, Colorado, and at the Colorado Mountain College Library, in Leadville, Colorado. The complete Administrative Record may also be reviewed at the EPA Superfund Record Center, located at 999 18th Street, 5th Floor, North Terrace in Denver, Colorado.

The State of Colorado has provided a letter for the Administrative Record, indicating its concurrence with the Selected Remedies.

ASSESSMENT OF THE SITE

The response action selected in this Record of Decision (ROD) is necessary to protect public health or welfare or the environment from actual or threatened releases of contaminants from OU8, which may present an imminent and substantial endangerment to public health or welfare.

DESCRIPTION OF THE SELECTED REMEDIES

The Lower California Gulch (OU8) is one of 11 OUs within the Site identified as source areas, and is defined by the 500-year floodplain of the California Gulch from immediately below the boundary of the Yak Tunnel Water Treatment Plant (OU1) to the point of the confluence of California Gulch with the Arkansas River, including the Colorado Zinc-Lead Tailing Impoundment. Pursuant to the August 26, 1994 Consent Decree at this Site, it was agreed that the decision on remediation of Site-wide Surface Water and Groundwater (i.e., OU12) would be made only after records of decision for source remediation were selected and implemented at

each OU. Remedial actions undertaken within the Lower California Gulch (OU8) site are consistent with the Resurrection work area management plan (WAMP)

Resurrection Mining Company (Resurrection), the potentially responsible party (PRP), has implemented two removal actions in OU8 pursuant to Action Memoranda issued by EPA. These interim removal actions were conducted in OU8 in order to enable use of the Oregon Gulch Tailing Impoundment (OU10) as a repository for excavated material from OU8.

Removal Actions

CZL Tailing Impoundment

An Engineering Evaluation/Cost Analysis (EE/CA) was performed to identify and evaluate potential removal actions for the CZL Tailing Impoundment and adjoining portions of Fluvial Tailing Site (FTS) 2. An Action Memorandum was issued in 1995 for the CZL Tailing Impoundment area based on the EE/CA. Pursuant to the Acton Memorandum approximately 28,000 cubic yards of material were excavated from the CZL Tailing Impoundment, the western portion of FTS2, and the underlying foundation soils and placed on the Oregon Gulch Tailing Impoundment (OU10). The excavated area was backfilled with clean borrow soil, graded, and vegetated. Wetlands adjacent to the CZL Tailing Impoundment site were vegetated in the summer of 1996.

Fluvial Tailing and Stream Sediment

An Action Memorandum was issued by EPA in June 1998 that selected the interim removal actions for fluvial tailing and stream sediment (EPA, 1998). This Action Memorandum was based on the Draft Focused Feasibility Study for Lower California Gulch, Operable Unit 8 (Sheppard Miller, Inc. and TerraMatrix [SMI/TerraMatrix], 1997) and a *Final Removal Action Plan for Selected Fluvial Tailing and Stream Sediment* (SMI/TerraMatrix, 1998). The interim removal actions are consistent with the alternatives for the remediation of fluvial tailing and contaminated stream sediment evaluated in the Focused Feasibility Study (FFS). The following interim removal actions were performed in conjunction with the planned remedial action in Oregon Gulch, OU10.

4. Approximately 5,794 cubic yards of fluvial tailing were excavated from poorly vegetated, erosion-prone areas within OU8 (specifically, FTS2, FTS3, FTS6, and FTS8). The excavated tailing was transported and placed on the Oregon Gulch Tailing Impoundment (OU10).

5. In conjunction with channel excavation, approximately 1,339 cubic yards of sediment were removed from accumulated sediment in FTS3 and FTS2. The excavated stream sediment was transported and placed on the Oregon Gulch Tailing Impoundment (OU10).

Remedial Action

The Selected Remedies for addressing the Lower California Gulch (OU8) are described below and are presented in the *Final Focused Feasibility Study for Lower California Gulch Operable*

Unit 8 (SMI/TerraMatrix, 2000). The FFS evaluated and screened remedial alternatives retained in the site-wide Screening Feasibility Study (EPA, 1993) for impounded tailing, non-residential area soils, waste rock, fluvial tailing, and stream sediment within the OU8 site. OU8 was divided into these specific media and the remedial alternatives were scoped for these media. The FFS presented a comparative analysis of the potential remedial alternative based on the nine NCP evaluation criteria and six WAMP criteria.

Impounded Tailing: EPA has selected Alternative 1 - No Further Action as the selected alternative for impounded tailing within OU8. No additional remediation would take place under this alternative. All tailing have been removed from the CZL Tailing Impoundment site and no other impounded tailing exist within OU8.

Non-Residential Area Soils: EPA has selected Alternative 2 - Containment as the selected alternative for non-residential area soils within OU8. The areas will be regraded to promote positive drainage and soil amendment added, and re-vegetated. Institutional controls will be implemented to provide notification that a vegetation barrier is in place and to restrict land use to protect the integrity of the remedy. Proposed modifications to Lake County and/or City of Leadville zoning ordinances involve the creation of a zoning "overlay district" to provide a screening process to identify properties where special precautions or requirements may be needed.

Waste Rock: EPA has selected Alternative 1 - No Action as the selected alternative for waste rock within OU8. No Action is necessary since the FFS shows that the Gaw waste rock pile is not a source of contamination to surface water or groundwater and is not a source of risk to human health or the environment.

Fluvial Tailing: EPA has selected Alternative 2 - Containment as the selected alternative for fluvial tailing within OU8. This alternatives consists of (1) regrading, (2) revegetation, (3) riprap or erosion-control matting in erosion-prone areas of fluvial tailing, and (4) institutional controls as described in Non-Residential Area Soils, Alternative 2.

Stream Sediment: EPA has selected Alternative 2 - Sediment Removal and Channel Reconstruction in FTS3 and FTS6 as the selected alternative for stream sediment within OU8. This alternative consists of (1) reconstruction of unstable braided channel areas of FTS3, (2) construction of a channel through FTS6, (3) removal of sediment and channel improvements in currently erosionally unstable areas, and (4) institutional controls as described in Non-Residential Area Soils, Alternative 2.

The Selected Remedies are protective of human health and the environment through the following:

- Containment of non-residential area soils and fluvial tailing will reduce the potential for erosion and leaching of metals.

- Containment of non-residential area soils will control airborne transport of contaminated materials and contaminant exposure to animals and aquatic life.

3. Ponding of water on the non-residential area soils and fluvial tailing will be minimized through selected regrading and revegetation.

4. Removal of stream sediment and channel reconstruction at selected areas will reduce the potential for erosion and leaching of metals into surface water and groundwater.

STATUTORY DETERMINATIONS

The Selected Remedies are protective of human health and the environment, comply with Federal and State requirements that are legally applicable or relevant and appropriate to the remedial action, and are cost effective. Given the type of waste present at this site, these remedies use permanent solutions (e.g., containment) to the maximum extent practicable. Because these remedies will result in hazardous substances, pollutants, or contaminants remaining on site above health-based levels that allow for unlimited use and unrestricted exposure, a review will be conducted within five years after initiation of remedial actions to ensure that the remedies are protective of human health and the environment. These remedies are acceptable to both the State of Colorado and the community of Leadville.

ROD DATA CERTIFICATION CHECKLIST

The following information is included in the Decision Summary section of this Record of Decision. Additional information can be found in the Administrative Record for this site.

- Contaminants of concern (COC) and their respective concentrations.
- Baseline risk represented by the COCs.
- Cleanup levels established for COCs and the basis for these levels.
- How source materials constituting principal threats are addressed.
- Current and reasonably anticipated future land use assumptions used in the baseline risk assessments and ROD.
- Potential land use that will be available at the site as a result of the Selected Remedies.
- Estimated capital costs, annual operation and maintenance costs, and total present worth costs, discount rate, and the number of years over which the remedy cost estimates are projected.
- Key factors that led to selecting the remedies.

Dale Vodehnal Acting ARA

Max H. Dodson
Assistant Regional Administrator
Ecosystems Protection and Remediation
U.S. Environmental Protection Agency, Region VIII

9/29/2000
Date

DECISION SUMMARY

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

TABLE OF CONTENTS (continued)

SECTION **PAGE**

LIST OF FIGURES

FIGURE

LIST OF TABLES

TABLE

LIST OF ACRONYMS AND ABBREVIATIONS

ABA	Acid-base accounts
AGP	Acid generating potential
AMSL	Above mean sea level
ANP	Acid neutralization potential
AOC	Administrative Order on Consent
APEN	Air Pollution Emission Notice
ARAR	Applicable or Relevant and Appropriate Requirements
AVIRIS	Airborne Visible/Infrared Imaging Spectroscopy
AWQC	Ambient water quality criteria
BARA	Baseline Aquatic Ecological Risk Assessment
bgs	Below ground surface
CD	Consent Decree
CDL	Colorado Department of Law
CDM	Camp Dresser & McKee, Inc
CDPHE	Colorado Department of Public Health and Environment
CDWR-SEO	Colorado Division of Water Resources, State Engineers Office
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
cm	Centimeter
cm/sec	Centimeter per second
COC	Contaminants of Concern
CWA	Clean Water Act
cy	Cubic yard
CZL	Colorado Zinc-Lead
DS	Direct Shear
EE/CA	Engineering Evaluation/Cost Analysis
EPA	U.S. Environmental Protection Agency
ERA	Ecological Risk Assessment
ESI	Engineering-Science, Inc.
FEC	Foothills Engineering Consultants, Inc.
FFS	Focused Feasibility Study
FS	Feasibility Study
ft	Feet
FTS	Fluvial Tailing Site
Golder	Golder and Associates, Inc.
HI	Hazard Index
HQ	Hazard Quotient
LL	Liquid limit
mg/kg	Milligrams per kilogram
mg/L	Milligrams per liter
NAAQS	National Ambient Air Quality Standard
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
ND	Non Detect

LIST OF ACRONYMS AND ABBREVIATIONS (continued)

NHPA	National Historic Preservation Act
NP	Non plastic
NPL	National Priorities List
NRHP	National Register of Historic Places
O&M	Operations and Maintenance
OU	Operable Unit
P	Proctor
pcf	Pound per cubic foot
Perm	Permeability
PL	Plastic limit
PI	Plasticity index
PRP	Potentially Responsible Party
psf	Pounds per square foot
psi	Pounds per square inch
P-III	P-III Associates, Inc.
RA	Risk Assessment
RAQ	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
Resurrection	Resurrection Mining Company
RI	Remedial Investigation
ROD	Record of Decision
SAP	Sampling Analysis Plan
SFS	Screening Feasibility Study
SHPO	State Historical Preservation Officer
SIP	State Implementation Plan,
SPLP	Synthetic Precipitation Leach Procedure
SMI/TerraMatrix	Sheppard Miller, Inc. and TerraMatrix, Inc.
State	State of Colorado
TBV	Toxicity Benchmark Values
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
TX	Triaxial test
UAO	Unilateral Administrative Order
UCL	Upper confidence limit of the arithmetic mean
USCS	Unified Soil Conservation System
USDC	U.S. District Court
WAMP	Work Area Management Plan
Weston	Roy F. Weston, Inc
WTP	Water Treatment Plant
WWC	Woodward Clyde Consultants
WWL	Water, Waste, and Land, Inc.
XRF	X-ray flourescence
EF	degrees Fahrenheit
lbs/day	Pounds per day

1.0 SITE NAME, LOCATION, AND DESCRIPTION

Lower California Gulch, Operable Unit 8
California Gulch Superfund Site
Leadville, Colorado
CERCLIS # COD980717938

The California Gulch Superfund Site ("the Site") is located in Lake County, Colorado, in the upper Arkansas River basin, approximately 100 miles southwest of Denver. The study area at the Site encompasses approximately 16.5 square miles and includes the towns of Leadville and Stringtown, a portion of the Leadville Historic Mining District, and the portion of the Arkansas River from its confluence, with California Gulch downstream to the Lake Fork Creek confluence (see Figure 1). Elevations range from approximately 12,300 feet above mean sea level (AMSL) near the summit of Ball Mountain to approximately 9,430 feet AMSL at the confluence of Lake Fork Creek with the Arkansas River.

The California Gulch Superfund Site has been organized into 12 Operable Units (OU). Figure 2 shows the Site study area boundaries and the location of the 12 OUs within the California Gulch Superfund Site. The U.S. Environmental Protection Agency (EPA) is the lead agency for the OU8 site and Colorado Department of Public Health and Environment (CDPHE) is the support agency. Resurrection Mining Company (Resurrection), a potentially responsible party (PRP), is financing the remedial actions for OU8.

OU8 is defined by the 500-year floodplain of the California Gulch from immediately below the boundary of the Yak Tunnel Water Treatment Plant (WTP) (OU1) to the point of the confluence of California Gulch with the Arkansas River and includes the Colorado Zinc-Lead (CZL) Tailing Impoundment as shown on Figure 3. OU8 is approximately 97 acres in size and approximately 4.3 miles long. OU8 borders portions of several other operable units including OUI (Yak Tunnel Treatment Plant), OU2 (Malta Gulch), OU3 (Denver and Rio Grande Western Railroad slag piles), OU5 (Asarco smelters/slag/mill sites), OU7 (Apache Tailing Impoundments), OU9 (Residential Populated areas), and OU10 (Oregon Gulch). Lower California Gulch receives runoff and water from tributaries that drain all or portions of these other operable units. Lower California Gulch also receives tributary water from upper California Gulch and Stray Horse Gulch via Starr Ditch, which drain areas of OU4 (Upper California Gulch) and OU6 (Starr Ditch/Penrose Dump/Stray Horse Gulch). Runoff from portions of Leadville and Stringtown, located within OU9, also drain to Lower California Gulch.

The land area within OU8 consists predominantly of private property, none of which is owned by Resurrection. While no residences are located in OU8, several anthropogenic features, primarily consisting of highway bridges, road crossings, and culverts, currently exist within the 500-year floodplain of Lower California Gulch. Lower California Gulch roughly parallels U.S. Highway 24.

2.0 OPERABLE UNIT HISTORY AND ENFORCEMENT ACTIVITIES

The California Gulch Superfund Site is located in the highly mineralized Colorado Mineral Belt of the Rocky Mountains. Mining, mineral processing, and smelting activities have produced gold, silver, lead, and zinc for more than 130 years in the Leadville area. The Leadville Historic Mining District includes an extensive network of underground mine workings in a mineralized area of approximately eight square miles located around Breece Hill. Mining in the District began in 1860, when placer gold was discovered in California Gulch. As the placer deposits were exhausted, underground workings became the principal method for removing gold, silver, lead, and zinc ore. As these mines were developed, waste rock was excavated along with the ore and placed near the mine entrances. Ore was crushed and separated into metallic concentrates at mills, with mill tailing generally slurried into tailing impoundments.

Fluvial tailing within OU8 were transported by surface flows, and deposited at specific locations in OU8. Likewise, stream sediments originating from source areas primarily upstream of OU8 are transported by California Gulch and associated tributaries into and within OU8 during high flow events. Stream sediment in Lower California Gulch has been contaminated with mine wastes and associated metals transported from upstream sources. Soluble metals contained in runoff have contributed to the contamination of surface water and sediments. The Gaw waste rock pile located upstream of the Apache Tailing Impoundments (OU7) near the boundary of OU8 represents the only deposit of waste rock identified within OU8. Non-residential area soils are located in areas where land use is zoned agricultural-forest, highway-business, and industrial-mining. Since OU8 constitutes the 500-year floodplain, residential use in OU8 is not reasonably anticipated.

The California Gulch Superfund Site was placed on the National Priorities List (NPL) in 1983, under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980. The Site was placed on the NPL because of concerns about the impact of mine drainage on surface waters in the California Gulch and the impact of heavy metals loading in the Arkansas River (EPA, 1997).

Several subsequent investigations have been conducted within the California Gulch Superfund Site that have addressed the Lower California Gulch (OU8). A number of investigations were conducted prior to the remedial investigations (RI) for the purpose of evaluating physical characteristics and potential contamination. These investigations included studies by EPA (EPA, 1987 and 1989), Colorado Department of Law (CDL) (CDL, 1986), and Water, Waste and Land, Inc. (WWL) (WWL, 1990)..

In September 1990, EPA and the PRPs entered into an Administrative Order on Consent (AOC) for the performance of soil sampling and air monitoring. EPA issued a Unilateral Administrative Order (UAO) in August 1991 that required Asarco to conduct studies and complete RIs.

Resurrection entered into a Consent Decree (CD) (U.S. District Court [USCD], 1994) with the United States, the State of Colorado (State), and other PRPs at the California Gulch Superfund Site on May 4, 1994. In the CD, Resurrection agreed to perform certain remediation work in three operable units (OU4, OU8, and OU10). The Work Area Management Plan (WAMP), included as Appendix D to the CD, defines the scope of work to be performed by Resurrection.

The cultural resources associated with the CZL Tailing Impoundment and the remainder of OU8 were surveyed in 1994 and 1995, respectively. The areas surveyed are discussed in greater detail in *Revised Draft Cultural Resources Survey of Colorado Zinc-Lead Mill Site and Tailing Area, Operable Unit 8* (FEC, 1995) and *Cultural Resource Inventory of Portions of Operable Unit 8 of the California Gulch CERCLA Site* (P-III, 1997).

Water, Waste, and Land, Inc. (WWL) conducted a hydrologic investigation of the California Gulch drainage for Resurrection Mining Company in 1989 (WWL, 1990). The primary objectives of the investigation were to characterize surface water and groundwater quality and flow patterns, and to identify sources of contaminant loading in California Gulch. The sample locations included California Gulch tributaries. Groundwater was sampled in the spring and fall of 1989 at monitoring wells previously installed by EPA in 1984 (CH2M Hill, 1986).

A surface water remedial investigation (Surface Water RI) of the California Gulch Site was conducted in 1991 and 1992. The final report describing the results of the investigation was issued by Golder and Associates in 1996 (Golder, 1996a). The primary objective of the Surface water RI was to collect surface water quality data to evaluate the physical and chemical characteristics of surface water in California Gulch and other drainages that may contribute contaminant loading to the Arkansas River. The investigation also evaluated the relative contributions and seasonal variations in loading from tributary drainages within California Gulch. The scope of the RI included California Gulch and associated tributaries, Evans Gulch, Empire Gulch, Iowa Gulch, Lake Fork, Halfmoon Creek, Tennessee Creek and the Arkansas River. California Gulch was sampled upstream and downstream of its confluence with Oregon Gulch, Starr Ditch, the CZL Tailing Impoundment, and other potential sources.

A groundwater remedial investigation (Hydrogeologic RI) at the California Gulch Superfund Site was conducted from the fall of 1991 through the winter of 1992. The study included monitoring well and piezometer installation, water level measurements, and groundwater sampling and analysis. The final Hydrogeologic RI Report describing the results of the investigation was issued by Golder and Associates in 1996 (Golder, 1996b). Objectives of the study were to investigate groundwater quality and flow directions, evaluate potential impacts to groundwater users and surface water receptors, and to characterize background groundwater quality. Groundwater discharges from springs and mine portals were also studied.

In the Hydrogeologic RI (Golder, 1996b), shallow perched groundwater was documented in Oregon Gulch, and in the Oregon Gulch, Colorado Zinc-Lead, and Apache Tailing Impoundments. The study includes estimates of hydraulic conductivities for the perched and intermediate alluvial aquifers and for saturated zones within tailing based on falling head and slug tests of the monitoring wells and piezometers. Analysis of groundwater levels in the alluvial aquifer mini-piezometers identified mounding of California Gulch groundwater and potential discharge of groundwater to the surface water flow in California Gulch just downstream of the confluence of California Gulch with tributary drainages (Airport Gulch, Georgia Gulch, and Oregon Gulch).

A RI of tailing impoundments and fluvial tailing sites in California Gulch was performed in the fall of 1991 and the *Final Tailings Disposal Area Remedial Investigation Report* (Tailing RI) was issued in 1994 (WCC, 1994). The primary objective of the investigation was to characterize the

physical nature of the tailing and to evaluate the potential impacts of tailing to surface water and groundwater. The Tailing RI concluded that the CZL Tailing Impoundment was a minor source of heavy metals and did not "exhibit significant acid mine drainage potential" (WCC, 1994a). Groundwater both upgradient and downgradient of the impoundment was characterized as degraded by metals, sulfate, and low pH when compared to data collected from the alluvial aquifer background monitoring wells. The downgradient wells were noted to potentially be influenced by sources other than the CZL tailing. Arsenic, cadmium, copper, lead, and zinc were detected at elevated levels in the CZL tailing. Arsenic, cadmium, copper, lead, and zinc were also detected in fluvial tailing samples at elevated concentrations.

SMI/TerraMatrix sampled groundwater, surface water, and stream sediment on behalf of Resurrection in October 1993, in May, June, and October 1994, and during 17 events between March 1995 and September 1996. The purpose of the program was to collect groundwater, surface water, and stream bed sediment data for California Gulch, its tributaries, and the Arkansas River. Water elevation data from area monitoring wells collected by Resurrection and Asarco have also been evaluated in the FFS. The data pertinent to OU8 were evaluated in the FFS.

A Proposed Plan describing the EPA's preferred alternatives was issued on July 27, 2000 (EPA, 2000). The preferred alternatives are listed as follow:

Impounded Tailing:	Alternative l - No Further Action
Non-Residential Area Soils:	Alternative 2 - Containment
Waste Rock:	Alternative 1 - No Action
Fluvial Tailing::	Alternative 2 - Containment
Stream Sediment:	Alternative 2 - Sediment Removal and Channel Reconstruction in Fluvial Tailing Site 3 and Fluvial Tailing Site 6

3.0 HIGHLIGHTS OF COMMUNITY PARTICIPATION

Public participation is required by CERCLA Sections 113 and 117. These sections require that before adoption of any plan for remedial action to be undertaken by EPA, the State, or an individual (e.g., PRP), the lead agency shall:

1. Publish a notice and make the Proposed Plan available to the public; and

2. Provide a reasonable opportunity for submission of written and oral comments and an opportunity for a public meeting at or near the site regarding the Proposed Plan and any proposed findings relating to cleanup standards. The lead agency shall keep a transcript of the meeting and make such transcript available to the public. The notice and analysis published under item #1 above shall include sufficient information to provide a reasonable explanation of the Proposed Plan and alternative proposals considered.

Additionally, notice of the final remedial action plan set forth in the record of decision (ROD) must be published and the plan must be made available to the public before commencing any remedial action. Such a final plan must be accompanied by a discussion of any significant changes to the preferred remedy presented in the Proposed Plan along with the reasons for the changes. A response (Responsiveness Summary) to each of the significant comments, criticisms, and new data submitted in written or oral presentations during the public comment period must be included with the ROD.

EPA has conducted the required community participation activities through the presentation of the RI/FS and the Proposed Plan, a 30-day public comment period, a formal public hearing, and the presentation, of the Selected Remedies in this ROD.

The Proposed Plan for Lower California Gulch (OU8) was released for public comment on July 27, 2000. The RI/FS documents and the Proposed Plan were made available to the public in the Administrative Record located at the EPA Superfund Records Center in Denver, the Lake County Public Library in Leadville, and the Colorado Mountain College Library in Leadville. A notice of availability of these documents was published in the Herald Democrat on July 27, 2000. A public comment period was held from July 27 to August 28, 2000. No comments were received during this public comment period.

On August 1, 2000, the EPA hosted a public meeting to present the Proposed Plan to the broader community audience than those that had already been involved at the site. The meeting was held at 7:00 p.m. in the Mining Hall of Fame and Museum in Leadville, Colorado. Representatives from Resurrection Mining Company presented the Proposed Plan, which discussed the following alternatives and preferred alternatives:

<u>Impounded Tailing</u>
Alternative 1 - No Further Action (preferred)

Non-Residential Area Soils
Alternative 1 - No Action
Alternative 2 - Containment (preferred)

Waste Rock
Alternative 1 - No Action (preferred)

Fluvial Tailing
Alternative 1 - No Action
Alternative 2 - Containment (preferred)

Stream Sediment
Alternative 1 - No Action
Alternative 2 - Sediment Removal and Channel Reconstruction in Fluvial Tailing Site 3 and Fluvial Tailing Site 6 (preferred)
Alternative 3 - Complete Sediment Removal and Channel Construction

A portion of the public meeting was dedicated to answering questions and accepting formal oral comments from the public. Community acceptance of the Selected Remedies are discussed in Section 10.0, Summary of Comparative Analysis of Alternatives, of this Decision Summary.

4.0 SCOPE AND ROLE OF OPERABLE UNIT

The California Gulch Superfund Site covers a wide area (Figure 2). As with many Superfund sites, the problems at the California Gulch Superfund Site are complex. As a result, EPA established the following OUs for the division of liability in geographically-or media-based areas within the Site. The OUs are designated as:

OUI Yak Tunnel/Water Treatment Plan
OU2 Malta Gulch Fluvial Tailing/Leadville Corporation Mill/Malta Gulch Tailing Impoundment
OU3 D&RGW Slag Piles/Railroad Easement/Railroad Yard and Stockpiled Fine Slag
OU4 Upper California Gulch
OU5 Asarco Smelter/Slag/Mill Sites
OU6 Starr Ditch/Penrose Dump/Stray Horse Gulch/Evans Gulch
OU7 Apache Tailing Impoundments
OU8 Lower California Gulch
OU9 Residential Populated Areas
OU10 Oregon Gulch
OU11 Arkansas River Valley Floodplain
OU12 Site-wide Water Quality

The Selected Remedies for OU8 address controlling airborne transport of contaminated materials of non-residential area soils, erosion, metal loading to surface water and groundwater, and contaminant exposure to animals and aquatic life. Remedial actions undertaken within OU8 are consistent with the remedial action objectives (RAO) and goals identified for the entire California Gulch Superfund Site.

This decision document makes no determination on whether surface water or groundwater within OU8 requires remediation. Pursuant to the August 26, 1994 CD at this Site, (USDC, 1994) it was agreed that the decision on remediation of Site-wide Surface Water and Groundwater (OU12) would be made only after remedies for source remediation were selected and implemented at each OU. As a result, specific water quality goals for Surface Water and Groundwater have not been established at this time.

5.0 SUMMARY OF SITE CHARACTERISTICS

Site characterization to assess the general conditions of the Lower California Gulch area and to evaluate the nature, and extent of contamination within OU8 is based on information presented in the *Final Focused Feasibility Study for Lower California Gulch, operable Unit 8* (SMI/TerraMatrix, 2000), *Final Tailings Disposal Area Remedial Investigation Report* (WCC, 1994), the *Final Surface Water Remedial Investigation Report* (Golder, 1996a), the *Final Hydrogeologic Remedial Investigation Report* (Golder, 1996b), and the *Field Investigation Data Report for the Apache Tailings Supplemental Remedial Investigation* (Golder, 1997)

5.1 IMPOUNDED TAILING

The CZL Tailing Impoundment, although lying outside of the 500-year floodplain, is included within OU8. There are no other tailing impoundments within OU8. The CZL tailing were moved to the Oregon Gulch Impoundment (OU10) in 1995 pursuant to a Removal Action (EPA 1995).

The CZL site is located in lower California Gulch approximately 1 mile west of Leadville immediately north of the community of Stringtown. The CZL flotation mill processed zinc-lead ores and was operated sporadically between 1925 and 1940. The tailing impoundment at the site covered approximately 1.6 acres at an average depth of 7 feet and contained an estimated 17,000 cubic yards of tailing (SMI/TerraMatrix, 1995b).

Tailing and soil material at the CZL Tailing Impoundment were sampled during the Tailing RI (WCC, 1994). The tailing contained high concentration of pyrite. Foundation materials beneath the impoundment primarily consisted of alluvium (silt, sand, gravel, and cobbles), but slag was encountered. Metals concentrations measured in the tailing samples were: arsenic, non detect (ND) to 264 milligrams per kilogram (mg/kg); cadmium, ND to 426 mg/kg; lead, 2,790 to 20,600 mg/kg; and zinc, 1,380 to 46,700 mg/kg. Synthetic Precipitation Leach Procedure (SPLP) (EPA Method 1312), which is a synthetic precipitation leaching test designed to simulate rainwater leaching of constituents from soil, were performed on 29 soil samples from the CZL Tailing Impoundment. The maximum analyte concentrations detected in the leachates were: arsenic, 1.31 milligrams per liter (mg/L); cadmium, 1.16 mg/L; lead, 3.41 mg/L; and zinc, 210 mg/L.

Airborne Visible/Infrared Imaging Spectroscopy (AVIRIS) data (EPA, 1996) in the vicinity of the CZL Tailing Impoundment site indicated the presence of pyrite, jarosite, and jarosite-geothite mineral assemblages. These assemblages have the potential to generate acid rock drainage (SMI/TerraMatrix, 2000).

5.2 NON-RESIDENTIAL AREA SOILS

Non-residential area soils are located in areas where land uses are zoned agricultural-forest, highway-business, and industrial-mining. As required in the WAMP (USDC, 1994), non-residential area soils within OU8 are evaluated in the FFS and this ROD in a manner consistent with current and likely future land use.
Non-residential area soils in OU8 are located primarily within 1.25 miles of the confluence of California Gulch with the Arkansas River. Smaller areas of non-residential area soils are located downstream of the Arkansas Valley Slag Pile, near the

LaPlata Slag Pile, and adjacent to FTS6. Approximately 6.3 acres, defined solely as non-residential area soils, are shown on Figures 4, 5, and 6.

Vegetative cover varies considerably throughout non-residential area soils from well vegetated with sagebrush and grasses to sparsely vegetated. Metals concentrations are generally low and typically decrease with depth to native, undisturbed soils in OU8. Soil pH values typically ranged from 5 (moderately acidic) to 8 (moderately alkaline), which are common values for mineral soils (Walsh & Associates [Walsh], 1992),

Two non-residential area soil samples were obtained in OU8 (Camp Dresser & McKee, Inc [CDM], 1994). Sample PG-182 is located near the upstream limit of FTS1 as shown on Figure 4. Sample PG-373 is located in FTS6 as shown on Figure 5. A summary of the X-ray flourescence (XRF) analysis results for samples PG-182 and PG-373 is included in Table 1.

AVIRIS data in areas of non-residential areas soils indicated predominantly hematite and goethite mineral assemblages with scattered indications of jarosite-goethite. Based upon the AVIRIS data, the mineral assemblages in non-residential areas soils generally have a lower capacity to generate acid rock drainage (SMI/TerraMatrix, 2000).

5.3 WASTE ROCK

The Gaw waste rock pile is the only waste rock deposit located within OU8. The Gaw waste rock pile is located within FTS6 between the Yak Tunnel Surge Pond and the Apache Tailing Impoundments (OU7). The pile covers approximately 0.5 acre and is estimated to have a volume of approximately 7,500 cubic yards. The pile surrounds the Gaw shaft opening, which is currently discharging water at a rate of approximately 0. 1 cubic feet per second.

The pile is sparsely vegetated with grass, sage, and medium-sized pine trees. Approximately 50 percent of the surface material is fine-grained, medium brown, gray, and tan soils. Approximately 30 percent of the pile is covered with gravel and small cobbles. The gravel and cobbles consist primarily of porphyry, quartzite, and chert, with minor amounts of limestone. No pyrite was observed.

AVIRIS data of the Gaw pile area indicated the presenc of goethite and hematite mineral assemblages with minor amounts of jarosite-geosite. Based on AVIRIS data, the waste rock pile has a lower potential for generating acid rock drainage (SMI/TerraMatrix, 2000).

Laboratory analysis of soil sample collected in 1995 indicated a pH of 8.1. No soil metal analytes were detected at concentrations considered to be phytotoxic. Analysis of the soil collected during 1996 indicated a total lead concentration of 170 mg/kg. Metals analysis of leachate produced by SPLP did not detect arsenic, cadmium, lead, or zinc.

The water quality from the Gaw Shaft discharge is relatively good. The pH has been observed to range from 5.79 to 6.69 standard units; sulfate concentrations have ranged from 244 to 300 mg/L; and with a few exceptions, metals are typically below detection (SMI/TerraMatrix, 2000).

5.4 FLUVIAL TAILING

The following sections summarize the characteristics of Fluvial Tailing Sites 1, 2, 3, 6 and 8 within OU8.

5.4.1 Fluvial Tailing Site 1

The FTS1 and FTS2 areas were addressed as one site in the Screening Feasibility Study (SFS) (EPA, 1993) and were referred to as the Stringtown Fluvial Tailing Site. However, these sites were delineated as two separate sites in the Tailing RI (WCC, 1994) and are discussed individually in this ROD. FTS1 lies adjacent to the LaPlata Slag Pile and extends downstream (west) to a point approximately 1,000 feet upgradient of the CZL Tailing Impoundment.

California Gulch flows through FTS1 and has incised several feet into the fluvial tailing. Tailing and alluvial/tailing material ranges from less than one foot to approximately six feet thick. Portions of the tailing are covered by alluvial tailing mixtures up to two feet thick. Alluvial sands, gravels, and cobbles underlie the tailing at this site. Grain sizes of the tailing material typically range from fine-to-coarse-grained sands. The portion of FTS1 within OU8 was estimated to cover 3.4 acres with an estimated total volume of approximately 5,500 cubic yards, assuming an average thickness of one foot (WCC, 1994). Vegetation on the fluvial tailing is variable with no vegetation over approximately 65 percent of the site. The remaining 35 percent of FTS1 is vegetated with grasses. Wetlands exist adjacent to the California Gulch channel.

Arsenic, cadmium, lead, and zinc concentrations were elevated in samples of surficial tailing deposits collected during the Tailing RI (WCC, 1994a). Subsurface tailing samples contained elevated concentrations of arsenic, cadmium, and lead. The Tailing RI identified foundation soils beneath the tailing deposit that contained elevated concentrations of cadmium, copper, lead, silver, and zinc. A summary of the laboratory results of the metals analysis and the SPLP analysis results for tailing samples collected during the Tailing RI is included in Table 2.

5.4.2 Fluvial Tailing Site 2

FTS2 lies 200 feet downstream (west) of FTS1, straddling the California Gulch channel just north of Stringtown (Figure 4). Fluvial tailing material in FTS2 is generally light brown to brown clayey silts and sands overlying a light brown silt containing cobbles and sand. California Gulch flows through the FTS2 site. The largest portion of the tailing deposit is located on the north bank of the California Gulch channel immediately east of the CZL Tailing Impoundment. Portions of FTS2 are devoid of vegetation with only isolated grasses on the tailing deposit. Dense vegetation is present in the area immediately adjacent to the channel.

FTS2 was estimated, in the Tailing RI (WCC, 1994) to encompass approximately six acres upstream of and adjacent to the CZL Tailing Impoundment with an average thickness of one foot. The area of FTS2 within OU8 is estimated to be approximately 3.2 acres and contains a volume of 5,200 cubic yards (WCC, 1994).

Arsenic, cadmium, lead, and zinc concentrations were elevated in samples of surficial tailing deposits collected during the Tailing RI (WCC,.1994). Subsurface tailing samples contained

elevated concentrations of arsenic, cadmium, and lead. The Tailing RI identified foundation soils beneath the tailing deposit that contained elevated concentrations of cadmium, copper, lead, silver, and zinc. A summary of the laboratory results of the metals analysis and the SPLP analysis results for tailing samples collected during the Tailing RI is included in Table 2.

5.4.3 Fluvial Tailing Site 3

FTS3 is located in California Gulch immediately downstream of County Road 6 (Landfill Road) as shown on Figure 7. Flows in California Gulch are split into north and south channels through most of FTS3. Most of the flow is currently in the north channel. FTS3 lies along a reach of California Gulch that has been the site of past dredging, placer mining, dumping and backfill activities, and stream sedimentation. Significant quantities of random fill, including asphalt, concrete, rubbish, and fill soils have been dumped adjacent to the north channel of California Gulch. Several springs emerge from a slope bordering California Gulch just north of FTS3. At one location, seep discharge is trapped behind fill material forming pools of stagnant water. Surface exposures of tailing/alluvium mixtures contain deposits of well-graded sands, gravels, and cobbles. Surface tailing are oxidized and exhibit a variety of colors including brown, orange, and yellow. FTS3 has been highly disturbed by excavation and backfill activities.

The site covers approximately 4.8 acres within OU8 and contains mixed alluvial and tailing deposits. The volume of the FTS3 tailing/alluvium mixture was estimated during the Tailing RI at 38,800 cubic yards, assuming an average depth of five feet (WCC, 1994a). Approximately 25 percent of FTS3 is vegetated with sagebrush, grasses, and marshy areas near the channel. Tailing deposits and areas containing recently deposited fill are generally devoid of vegetation.

Arsenic, cadmium, lead, and zinc concentrations were elevated in samples of surficial tailing deposits collected during the Tailing RI (WCC, 1994). Subsurface tailing, samples contained elevated concentrations of arsenic, cadmium, and lead. The Tailing RI identified foundation soils beneath the tailing deposit that contained elevated concentrations of cadmium, lead, and silver. One soil sample was collected from three locations in FTS3 (CDM, 1994). A summary of the laboratory results of the metals analysis and the SPLP analysis results for tailing samples collected during the Tailing RI and the XRF results is included in Table 2.

5.4.4 Fluvial Tailing Site 6

Fluvial Tailing Site 6 (FTS6) is located in California Gulch between the Yak Tunnel Treatment Plant Surge Pond embankment and the Apache Tailing Impoundments (Figure 5). The tailing at FTS6 is oxidized, moist, yellow-orange to brown clay with silts and sands also present. Vegetation in FTS6 ranges from sparse grasses with isolated pine trees to unvegetated (approximately 60 percent of the site). FTS6 encompasses approximately 4.2 acres within OU8. The tailing materials exist as a thin veneer covering the natural alluvium at thicknesses generally between 0 and 6 inches, and occasionally up to one foot. The volume of fluvial tailing in FTS6 was estimated to be approximately 3,400 cubic yards (SMI/TerraMatrix, 1995a) as presented in Table 3. A portion of the Gaw waste rock pile is also located within FTS6.

Soil samples collected from the site were analyzed in three studies (WCC, 1994; CDM, 1994)SMI, 1995). Arsenic, cadmium, lead, silver, and zinc concentrations were elevated in samples of

surficial soils. Subsurface soil samples contained elevated concentrations of arsenic, cadmium, lead, and zinc (Table 2).

Arsenic, cadmium, copper, lead, mercury, and zinc concentrations were elevated in samples of surficial tailing deposits collected during the Tailing RI (WCC, 1994). Subsurface tailing samples contained elevated concentrations of arsenic, cadmium, copper, lead, manganese, mercury, and zinc. The Tailing RI identified foundation soils beneath the tailing deposit that contained elevated concentrations of arsenic, cadmium, copper, lead, and zinc. Soil samples were collected from three locations in FTS3 (CDM, 1994). A summary of the laboratory results of the metals analysis and the SPLP analysis results for tailing samples collected during the Tailing RI and the XRF results is included in Table 2.

AVIRIS data in FTS6 indicated the presence of predominantly the geothite mineral assemblage with a small area of jarosite-goethite in the central portion of the site. The jarosite-goethite assemblage has a greater potential of generating acid rock drainage.

5.4.5 Fluvial Tailing Site 8

Fluvial Tailing Site 8 (FTS8) extends from the Arkansas Valley Slag Pile to a point approximately 6,500 feet downstream of the confluence of the Arkansas River with California Gulch (Figure 6). FTS8 consists of a series of small, discontinuous tailing deposits scattered along Lower California Gulch. The tailing are often interlayered with alluvial sediments and are classified as unconsolidated sandy silts and sands. The surface tailing are partially oxidized and exhibit a variety of colors including tan, brown gray, yellow, and orange. At the test hole and trench locations, the tailing ranged in thickness from 6 to 18 inches. The Tailing RI report, however, estimated the volume of the tailing in FTS8 over 115 acres at a depth of 4 inches at approximately 46,000 cubic yards of material (WCC, 1994).

Arsenic, cadmium, copper, lead, and zinc concentrations were elevated in samples of surficial tailing deposits collected during the Tailing RI (WCC, 1994). Subsurface tailing samples contained elevated concentrations of arsenic, cadmium, lead, and zinc. The Tailing RI identified foundation soils beneath the tailing deposit that contained elevated concentrations of cadmium. One soil samples was collected from three locations in FTS6 (CDM 1994). A summary of the laboratory results of the metals analysis and the SPLP analysis results for tailing samples collected during the Tailing RI and the XRF results is included in Table 2.

AVIRIS data in FTS6 indicates predominantly hematite and geothite mineral assemblages with scattered indications of jarosite-goethite. Based upon the AVIRIS data, the majority of mineral assemblages in FTS 8 have a lower capacity to generate acid rock drainage.

This ROD only addresses that part of FTS8 within the 500-year floodplain boundary (OU8) as shown in Figure 6. Within OU8, FTS8 encompasses an area of approximately 45 acres stretching along California Gulch for a distance of approximately 10,000 feet. Approximately 18,200 cubic yards of tailing within FTS8 were estimated to exist within OU8 (Table 3). Vegetation in FTS8 ranges from non-existent to dense grasses and shrubs located adjacent to the California Gulch channel. Approximately 20 percent of FTS8 is well vegetated.

5.5 STREAM SEDIMENT

California Gulch stream sediments were identified as a contaminant source in the SFS (EPA, 1993). Sediment transport is described in the Surface Water RI as "one of the major metals transport mechanisms within California Gulch" (Golder, 1996a). Soil particles, eroded from upstream sources by precipitation and spring snowmelt, are transported by tributaries and overland flow into California Gulch. These sediments, when deposited in a given reach of California Gulch, may later be re-suspended and subsequently transported downstream.

Sediment lining the bottom of several reaches of the California Gulch channel have typically been cemented together forming a hard substrate referred to as "ferricrete." This material is typically orange in color as it comprised of iron-rich sediments. In the present stream environment, these sediments are largely immobile and are not a secondary source of contaminant release. Water quality data from reaches of California Gulch where stream sediments are the only potential contaminant source generally do not demonstrate any increase in metal loading to surface water or groundwater.

Downstream of FTS3, stream sediments were impounded in 1996 upstream of a partially blocked 36-inch diameter culvert that conveyed California Gulch stream flow at a road crossing (Dorothy Hayes' property, Figure 7). In 1995, California Gulch flow pounded upstream of the culvert and periodically overtopped the berm. The blocked culvert was removed from the stream channel prior to the spring runoff event of 1996 and approximately 500 cubic yards of sediment were excavated and relocated to the Oregon Gulch Impoundment (OU10).

The lower California Gulch channel within OU8 is approximately 4.3 miles long. Assuming an average sediment depth of one foot and an average width of 5 feet, the volume of iron-cemented stream sediments in the active channel of California Gulch was estimated to be approximately 4,500 cubic yards. Due to the dynamic nature of California Gulch, the total volume of loose, erodible stream sediments varies both seasonally and from year to year depending on flow conditions (SMI/TerraMatrix, 2000).

Analysis of sediment chemistry results focused on four sampling locations where samples were most frequently collected. The sampling sites included in this analysis are: CD-3, downstream of Apache Tailing Impoundments (OU7); CG-4, downstream of FTS3; CG-5, downstream of CZL Tailing Impoundment; and CG-6, in California Gulch just upstream of the confluence with the Arkansas River. Figures 8 through 11 illustrate sediment concentrations for lead, arsenic, cadmium, copper, and zinc at these four sampling locations

5.6 GROUNDWATER CONDITIONS

The Hydrogeologic RI (Golder, 1996b) identified both alluvial and bedrock aquifer systems in OU8. However, the results of the Hydrogeologic RI indicated that only the alluvial or shallow aquifer is contaminated by surface constituents. The Hydrogeologic RI identified that groundwater concentrations in Lower California Gulch were elevated for arsenic, cadmium, copper, lead, sulfates, and zinc, but that the metal contamination was confined to the upper few feet of the alluvial aquifer. The Tailing RI (WCC, 1994) identified the following metals detected in alluvial aquifer groundwater at concentrations above background conditions: arsenic, beryllium,

cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, and zinc (WCC, 1994). Elevated sulfate concentrations were also identified.

Groundwater quality samples and water elevation measurements have been collected from selected monitoring wells in OU8 since 1993. In addition, EPA installed 21 alluvial aquifer monitoring wells (NW1-NW21) within the California Gulch site in 1984. Four alluvial aquifer monitoring wells (ABW1 - ABW4) and 11 alluvial aquifer piezometers (PZ1 - PZ11) were also installed during the Hydrogeologic RI. Results from these sampling events were used to characterized the hydrogeologic conditions of the alluvial aquifer.

Surface water quality criteria were utilized to identify contaminants of concern (COC) for OU8 groundwater because of the potential of interaction between surface water and groundwater at the California Gulch Superfund Site. Based on the Baseline Aquatic Ecological Risk Assessment (BARA) (Weston, 1995a), the COCs evaluated for surface water were cadmium, copper, and zinc based on acute exposure risk to aquatic life and arsenic, mercury, nickel, and selenium based on chronic exposure risk to aquatic life in the Arkansas River. In addition to these COCs, lead, sulfates, and total dissolved solids were also analyzed in RI samples for groundwater characterization purposes.

Alluvial groundwater quality data was collected different areas along the aquifer. A discussion of wells sampled and the results of the sample analysis for each area is presented below.

Upgradient of the Apache Tailing Impoundment (Including Fluvial Tailing Site 6)

Monitoring well AP1TMW7 is located approximately 700 feet upgradient of the Apache Tailing Impoundment (OU7) and is screened in the alluvial aquifer between 62 and 72 feet bgs. Groundwater samples from AP1TMW7 collected between 1991 and 1994 showed an average pH of 7.4 and an average arsenic concentration of 0.02 mg/l.

Monitoring well NW5A, located upgradient of FTS6 and the Apache Tailing Impoundments (OU7) is screened between 15 and 35 feet bgs. Groundwater samples collected from NW5A between October 1993 and October 1994 showed elevated average metal concentrations of 430 mg/l for zinc, an average sulfate concentration of 4,177 mg/l, a total dissolved solids (TDS) range of 4,320 mg/l to 5,298 mg/l, and a pH range of 5.97 to 6.66.

Within the Apache Tailing Impoundment

The Apache Tailing Impoundments, located in OU7 upgradient of most of OU8 (Figure 3), was characterized as a source of acid drainage in the Tailing RI (WCC, 1994). Analyses of pore water samples from monitoring well AP1TMW9 showed an average pH from 6.14 to 6.84, an average sulfate concentration of 6,123 mg/L, and average TDS concentrations of 8,223 mg/L. Potential seepage from the Apache Tailing Impoundment may occur at a spring located along the tailing embankment (SPR9). The water quality of this spring water is discussed below.

Between Apache Tailing Impoundment and Fluvial Tailing Site 3

Downgradient of the Apache Tailing Impoundment in alluvial monitoring wells AP1TMW1, AP1TMW2, and AP1TMW3, elevated groundwater concentrations of dissolved metals, sulfate, and total dissolved solids were detected in samples collected between November 1991 and June 1996. The downgradient monitoring well nearest to the main Apache Tailing Impoundments (OU7) is AP1TMW2. Samples from AP1TMW2 had an average cadmium concentration of 0.004 mg/L and an average zinc concentration of 9.7 mg/L. The arsenic, copper, and lead concentrations were not detected. The sulfate concentration averaged 470 mg/L and TDS averaged 748 mg/L. The average pH for AP1TMW2 was 6.6 standard units.

Groundwater samples collected from monitoring well AP1TMW1, located approximately 750 feet downgradient and west of the main Apache Tailing Impoundments (OU7) showed some elevated metal concentrations. AP1TMW1 samples had an average cadmium concentration of 0.3 mg/L, average copper concentration of 0.6 mg/L, and average lead of 0.62 mg/L. The highest arsenic concentration was 0.02 mg/L. Sulfate averaged 3,025 mg/L, TDS averaged 5,085 mg/L, and zinc averaged 161 mg/L. The pH at AP1TMW1 averaged 4.4 standard units.

Monitoring well AP1TMW3 is located at the upstream edge of FTS3 (Figure 3), approximately 1,000 feet west of the main Apache Tailing Impoundment. The concentrations of arsenic, cadmium, copper, and lead in groundwater samples from AP1TMW3 were typically below detection limits. Zinc concentrations in AP1TMW3 averaged 0.19 mg/L, pH averaged 6.96, sulfate concentrations averaged 143 mg/L, and TDS averaged 337 mg/L .

Water samples from spring SPR9, located on the southwest embankment of the Apache Tailing Impoundment had metals concentrations elevated above concentrations detected in tailing pore water collected from Apache Tailing monitoring well AP1TMW9. Constituent concentrations detected in samples from SPR9 may be indicative of groundwater quality in the tailing. In samples collected between October 1989 and October 1994, cadmium concentrations varied from non-detect to 0.25 mg/L, copper varied from 0.01 to 0.12 mg/L, and zinc varied from 51 to 120 mg/L in SPR9. Sulfate varied from 860 to 1,300 mg/L and field pH ranged from 5 to 7 standard units in SPR9 samples.

Upgradient of Fluvial Tailing Site 3

Fluvial Tailing Site 3 (FTS3) is located in Lower California Gulch extending downstream approximately 1,700 feet to the west from County Road 6 (Figure 3). Groundwater conditions upgradient of FTS3 can be represented by alluvial monitoring well AP1TMW3. For sampling events on AP1TMW3 between 1991 and 1994, arsenic and copper concentrations were below the detection limit, lead concentrations averaged 0.002 mg/L, sulfate concentrations averaged 143 mg/l, TDS concentrations averaged 337 mg/L, and zinc concentrations averaged 0.2 mg/L.

The shallow, perched aquifer in Oregon Gulch discharges to the alluvial aquifer in Lower California Gulch at the confluence of Oregon Gulch with California Gulch (Golder, 1996b) (Figure 3). Groundwater quality in Oregon Gulch was evaluated using sampling results from monitoring well OG1TMW3, located approximately 1,100 feet upstream of the confluence of Oregon Gulch with California Gulch. Groundwater samples collected between 1991 and fall of

1996 from OG1TMW3 contained average arsenic concentrations of 0.15 mg/L, average cadmium concentrations of 0.45 mg/L, average copper concentrations of 5.2 mg/L, and average lead concentrations of 0.04 mg/L. Sulfate concentrations averaged 27,096 mg/L, TDS averaged 41,748 mg/L, and zinc averaged 773 mg/L.

Downgradient of Fluvial Tailing Site 3

Alluvial aquifer monitoring wells NW6 and NW6A are located approximately 1,600 feet downgradient (west) of the AP1TNW3 monitoring well. At NW6A, the average cadmium concentration was 0.108 mg/L, the average copper concentration was 0.014mg/L, the average lead concentration was 0.006 mg/L, and average zinc was 35.5 mg/L. Well NW6A had an average sulfate concentration of 1,310 mg/L, an average TDS concentration of 1,590 mg/L, and a pH of 6.46. Although higher than concentrations detected at upgradient well AP1TMW3, the groundwater concentrations of sulfate, TDS, and zinc decreased from 1989 through 1994 at well NW6A. The decline in concentrations at NW6A is possibly indicative of groundwater quality improvement following initiation of treatment of Yak Tunnel discharge in 1992. Field conductivity also declined and pH increased over the same time interval.

Additional potential constituent sources within the reach include groundwater and surface water infiltration from Starr Ditch and Oregon Gulch. Infiltration of California Gulch surface flows upgradient of the reach is also a possible source of groundwater constituents in this reach.

Upgradient of Fluvial Tailing Site 1

Fluvial Tailing Site 1 (FTS1) is located north of Highway 24 downstream of the LaPlata Slag pile (Figure 3). Groundwater quality upgradient of FTS1 was delineated by the analytical results of samples from EPA-installed monitoring well NW15. The average concentrations of arsenic, copper, and lead were below the detection limit. Cadmium concentration averaged 0.021 mg/L, zinc averaged 13.5 mg/L, sulfate averaged 443 mg/L, TDS averaged 776 mg/L, and pH averaged 6.51 in NW15. The averages were based on three sampling events between October 1993 and October 1994.

Georgia Gulch surface flows discharge to California Gulch approximately 2,200 feet upstream of FTS1. A portion of ephemeral surface flows in Georgia Gulch infiltrate to the alluvial aquifer and potentially discharge to California Gulch in a gaining stream reach downstream of the confluence of the two drainages. Analytical results of samples from piezometers PZ6 and PZ7, located southeast of California Gulch, were utilized to characterize Georgia Gulch groundwater. Groundwater samples from these wells had elevated sulfate and TDS concentrations. Arsenic, cadmium, copper, and lead concentrations were at or near the detection limits.

Groundwater flow in the historic channel of Lower Stray Horse Gulch may also potentially discharge to the California Gulch alluvium. Concentrations of TDS and sulfate were elevated in groundwater samples collected between October 1994 and June 1996 from monitoring wells SHMW1, SHMW2, and SHMW3. Cadmium and zinc were elevated in SHMW1B. The field pH averaged 6.6 for all of the SHMW monitoring wells. Arsenic, copper, and lead concentrations were near the detection method limit for each constituent.

Downgradient of Fluvial Tailing Site 1

Groundwater quality downgradient of FTS1 is represented by samples collected from monitoring well CZ1TMW1 between November 1991 and September 1995. At CZ1TMW1, groundwater concentrations of cadmium averaged 0.11 mg/L, lead averaged 0.002 mg/L, and zinc averaged 46.4 mg/L. The average sulfate concentration was 626 mg/L, the average TDS concentration was 965 mg/L, and the pH averaged 6.23. The concentrations at CZ1TMW1 were typically greater than the concentrations at NW15, which is representative of groundwater quality upgradient of FTS1. Additional constituent sources adjacent to OU8 within this reach of California Gulch include the LaPlata slag pile, and SPR4.

Upgradient of the CZL Tailing Impoundment

Characterization of groundwater quality in the vicinity of the CZL Tailing Impoundment was described in the EE/CA (SMI/TerraMatrix, 1995b). Groundwater quality in the alluvial aquifer upgradient of the CZL Tailing Impoundment was characterized in this ROD by evaluating results of samples collected from monitoring well CZ1TMW1 located approximately 400 feet upgradient of the CZL Tailing Impoundment (Figure 3). Potential constituent sources in the vicinity of monitoring well CZ1TMW1 include infiltration of California Gulch surface flows and leaching of metals from the LaPlata Slag pile and fluvial tailing. Dissolved metals, sulfate, and TDS concentrations in groundwater samples from monitoring well CZ1TMW1 were elevated. Table 4 presents a summary of the analytical results from groundwater monitoring at CZ1TMW1.

Within the CZL Tailing Impoundment

The CZL Tailing Impoundment was characterized as a source of acidic drainage in the Surface Water RI (Golder, 1996a). Laboratory results of groundwater samples collected in November 1991 from monitoring well CZ1TMW4 located within the tailing, indicated elevated dissolved metal concentrations (Table 4). The CZL tailing were removed in 1995 pursuant to an Action Memorandum (EPA, 1995).

Downgradient of the CZL Tailing Impoundment

Groundwater samples from alluvial aquifer monitoring well CZ1TMW7A located downgradient of the CZL impoundment had an average pH value of 3.0 and an average sulfate concentration of 2,770 mg/L. Total dissolved solids averaged 4,201 mg/L in CZ1TMW7A. Pre-removal action metal and sulfate concentrations in downgradient monitoring well CZ1TMW8 were elevated compared to the concentrations at upgradient well CZ1TMW1 (Table 4). Additional potential constituent sources in the reach include fluvial tailing, slag piles, and infiltration of surface water from Lower California Gulch.

Upgradient of Fluvial Tailing Site 8

Monitoring well NW11 is located upgradient of FTS8, The analytical results from this well are included in Table 4. Groundwater samples from NW11 had neutral pH and concentrations of dissolved metals, TDS, and sulfate that were elevated. Within the upstream portion of FTS8, monitoring well NW8 had average metal concentrations, as shown in Table 4, that were similar to

average concentrations detected in monitoring well NW11. However, sulfate, TDS, and conductivity values at NW8 were approximately two times the concentrations detected in NW11 (Table 4).

Within Fluvial Tailing Site 8

Further downgradient within FTS8 at monitoring well NW13A, dissolved metals concentrations were elevated as compared to the average concentrations detected in upgradient monitoring wells NW11 and NW8 (Table 4). However, the average TDS, conductivity, and sulfate concentrations at NW13A were lower than the concentrations at NW8 (Table 4).

Remediation of groundwater will be addressed at a later date if necessary. EPA has agreed to establish specific groundwater requirements at a later date when EPA and CDPHE have determined the allowable water quality standards pursuant to OU12 (Site-wide Water Quality).

5.7 HISTORIC AND CULTURAL RESOURCES

As a result of cultural resource investigations in OU8 (P-III, 1997), the ruins of the historic Gaw Brewery site (Site 5LK897) were determined eligible for nomination to the National Register of Historic Places and also determined to be a contributing element of the proposed Leadville Mining Historic District (P-III, 1997). Site 5LK897 consists of the remains of the Gaw Brewery including foundation ruins, boiler and barrel remains, structural and other wood, and topographic features. Also included are various miscellaneous glass, artifacts, and debris. This site is located upstream (east) of the Apache Tailing Impoundments (OU7), to the south of FTS6.

6.0 CURRENT AND POTENTIAL FUTURE LAND USE

Land surrounding and within the California Gulch Superfund Site is predominately dedicated to mining, commercial, residential uses. Lower California Gulch (OU8) is located within an area zoned for industrial use by the City of Leadville. The property within OU8 is not currently being utilized by any entity. Land within OU8 consists predominantly of private property, none of which is owned by Resurrection. No residences are located in OU8, several anthropogenic features primarily consisting of highway bridges, road crossings, and culverts currently exist within the 500-year floodplain of Lower California Gulch.

Since OU8 constitutes the 500-year floodplain, residential use in OU8 is not reasonably anticipated.

7.0 SUMMARY OF SITE RISKS

Baseline risk assessments (RA) characterize potential human health and ecological risks at a site based on current conditions (i.e., no action taken at the site). Remedial action is driven in part by the potential for human health or ecological risk; the RA indicates the media and exposure pathways to be addressed. The human health and ecological RAs were conducted for the California Gulch Superfund Site as a whole site and not for the individual OUs. However, the information for OU8 demonstrated the potential only for ecological risks; risks were not demonstrated for human health. Contaminants, receptors, exposure pathways, and baseline risks at OU8 are described below.

7.1 HUMAN HEALTH RISKS

The following human health RAs are pertinent to OU8:

- Weston. 1991. Preliminary Human Health Baseline Risk Assessment for the California Gulch NPL Site, Leadville, Colorado. Prepared by Roy. F. Weston, Inc. for the EPA. December. (Preliminary RA).

- Weston. 1996a. Baseline Human Health Risk Assessment for the California Gulch Superfund Site Risk to Residents from Lead (Part A). Prepared by Roy. F Weston, Inc. for the EPA. January.

- Weston. 1996b. Baseline Human Health Risk Assessment for the California Gulch Superfund Site, Risk to Residents from Contaminants Other Than Lead (Part B). Prepared by Roy. F. Weston, Inc. for the EPA. January.

- Weston. 1995a. Baseline Human Health Risk Assessment for the California Gulch Superfund Site, Part C: Evaluation of Worker Scenario and Evaluation of Recreational Scenarios. Prepared by Roy. F. Weston, Inc. for the EPA. April.

The preliminary RA (Weston, 1991) evaluated residential risks from exposure to contaminated media (i.e., soil, waste rock, tailing, etc). Since the completion of the preliminary RA, several studies were completed that provided additional data on contaminant concentrations and on human and ecological exposures. Additionally, Leadville officials and business leaders expressed concern over possible risks and liabilities associated with commercial and recreational uses within the California Gulch Superfund Site. The final baseline RA (Weston, 1995a, 1996a, and 1996b) was composed of the following three parts:

- Part A Risk to Residents from Lead - evaluated residential risk from exposure to lead;
- Part B Risk to Residents from Contaminants Other than Lead - evaluated risk to residents from exposure to contaminants other than lead; and
- Part C Evaluation of Recreational Scenarios and Evaluation of Worker Scenario - developed in response to community concerns, presented risk-based action levels to determine whether chemical concentrations presented a risk at locations used for commercial, industrial, or recreational purposes.

The following sections summarize the results of these RAs, including media and contaminants of concern, exposure assessment, and risk characterization, as they relate to OU8.

7.1.1 Media and Contaminants of Concern

Potential media of concern in OU8 consists of impounded tailing, non-residential soils, waste rock, fluvial tailing, and stream sediment. Results of the preliminary RA (Weston, 1991) and the final RA (Weston, 1995a) indicate that human receptors are expected to have minimal exposure to slag. Both the preliminary and final RA indicate that soil is the medium of concern for human exposure. Arsenic and lead were used as indicator contaminants (i.e., drivers) for risk in the final RA (Weston, 1995a). These chemicals were selected based on the results of the preliminary RA (Weston, 1991), which indicate that lead and arsenic are responsible for the majority of human health risks at the California Gulch Superfund Site.

7.1.2 Exposure Assessment

Residential use of OU8 does not currently occur, nor is future residential use reasonably anticipated. Commercial, industrial, and recreational uses are expected at OU8 because the site is currently zoned for industrial use. Therefore, human receptors of concern at OU8 are commercial and industrial workers and recreational visitors.

The preliminary RA (Weston, 1991) identified potential primary sources of metals of concern, the mechanisms of release to the environment, and receptors in a conceptual site model, which is shown on Figure 12. The final RA (Weston, 1995a) identified soil ingestion as the exposure pathway of concern for recreational visitors; ingestion of soil and dust was identified as the exposure pathway of concern for commercial/industrial workers. Exposure to other media (e.g., slag piles) and exposure to soil/dust through other pathways (e.g., dermal) are considered of insignificant concern for commercial/industrial workers and recreational users (Weston, 1991).

7.1.3 Risk Characterization

The final RA (Weston, 1995a) developed risk-based action levels for lead and other metals. Arsenic and lead have been identified as the primary metals of concern related to potential human health risks at the California Gulch Superfund Site. The action levels developed in the final RA represent risk-based chemical concentrations that are protective of human health and can be compared to contaminant concentrations in soil to identify areas of potential concern to commercial/industrial workers or recreational visitors. The action levels should be compared to the average concentration across the exposure area; they do not represent maximum allowable concentrations (i.e., concentrations not to be exceeded). The action levels, presented as a range, represent the low and high values calculated based on the uncertainties and variations of the exposure parameters.

For commercial/industrial exposure, the soil action level for lead ranges from as low as 2,200 mg/kg to as high as 19,100 mg/kg, which is based on widely varying exposure parameters, with central tendency values in the 6,100 to 7,700 mg/kg range. Soil action level for arsenic based on commercial/industrial exposure range from 330 to 1,300 mg/kg, which is based on widely varying exposure parameters, with central tendency values in the 610 to 690 mg/kg range.

For recreational exposure, the soil action level for lead ranged from as low as 5,000 mg/kg to as high as 85,000 mg/kg, depending on the input parameters. The lead concentration for recreational exposure was 16,000 mg/kg, which is the action level calculated in the RA (Weston, 1995a). For arsenic, soil action levels for recreational exposure ranged from 1,400 to 3,200 mg/kg based on carcinogenic and systemic effects, respectively. The most appropriate arsenic concentration for use as a recreational action level was 1,400 mg/kg, based on the potential for carcinogenic effects.

The action levels are summarized below:

COC	Soil Action Levels, mg/kg	
	Commercial/Industrial	Recreational
Lead	6,100 - 7,700	16,000
Arsenic	610 - 690	1,400 - 3,200

Although some individual samples exceeded human health action levels, the average lead and arsenic concentrations for surficial samples of fluvial tailing and soil within OU8 are less than the action levels developed for commercial workers and recreational visitors. The RA concluded the mean lead and arsenic concentrations for fluvial tailing and soils in OU8 are unlikely to result in risks to commercial workers or recreational visitors within OU8.

7.2 ECOLOGICAL RISKS

Baseline RAs characterizing ecological risks at OU8 consist of

- *Final Baseline Aquatic Ecological Risk Assessment* (Weston, 1995b) (BARA).
- *Ecological Risk Assessment for the Terrestrial Ecosystem* (Weston, 1997) (ERA).

The BARA (Weston, 1995b) characterizes the impacts of mine waste contamination on the aquatic ecosystem of the California Gulch Superfund Site. The BARA provides a conceptual model of exposure at the California Gulch Superfund Site for aquatic receptors and identifies surface water and sediments as the exposure pathways of concern as these media are the most direct and significant means of exposure for receptors (Figure 13). Data in the BARA were evaluated by sampling location rather than by OU as a whole.

Potential risks to the terrestrial ecosystem from mine waste contamination are characterized in the ERA (Weston, 1997). The ERA provides a conceptual site model for terrestrial receptors at the California Gulch Superfund Site and is shown in Figure 14. In the ERA, the potential for adverse effects was evaluated on a station by station basis and on an OU basis.

7.2.1 Media and Contaminants of Concern

The BARA (Weston, 1995b) identifies the potential for adverse effects to the aquatic ecosystem due to mine waste contamination and evaluates the ecological risks prior to and subsequent to the commencement of operations of the WTP. Data from surface water and sediment sampling events in 1991 were used to represent the period prior to operation of the WTP, and data collected from 1992 to 1994 were considered for the time period subsequent to initiation of water treatment by the WTP. Contaminants evaluated in the BARA consist of aluminum, antimony, arsenic, barium, cadmium, copper, iron, lead, manganese, nickel, selenium, and zinc.

Media evaluated in the ERA for the terrestrial ecosystem included sediment, waste rock, surface soil, tailing, slag, and surface water; the media of concern varied by OU. Only data from the top two inches of media were evaluated in the ERA. Contaminants evaluated in the ERA consisted of antimony, arsenic, barium, beryllium, cadmium, chromium, copper, lead, nickel, manganese, mercury, silver, thallium, and zinc.

7.2.2 Exposure Assessment

Potential exposure pathways for aquatic receptors identified in the BARA (Weston, 1995b) were ingestion of metals in surface water, sediments, and dietary items and direct contact with metals in surface water, sediments, and modeled concentrations of dissolved metals in sediment pore water. However, only the direct contact pathways were quantitatively addressed in the BARA. Ecological receptors evaluated in the BARA included aquatic plants, benthic macroinvertebrates, and fish (primarily trout species).

The ERA (Weston, 1997) defined both direct and indirect exposure pathways to the terrestrial ecosystem. Direct exposure pathways included exposures to surface soils, slag, waste rock, and tailing for birds and animals that frequent upland areas, and exposure to fluvial tailing and sediment in riparian areas. The following direct exposure pathways were evaluated in the ERA:

- Soil ingestion as part of feeding, burrowing, or grooming activities;
- Plants and soil invertebrates directly exposed to soil;
- Ingestion of contaminated ponded water or surface water;
- Incidental ingestion of sediments/fluvial tailing while feeding; and,
- Ingestion of food items such as vegetation, invertebrates, or small mammals.

Receptors were selected to best reflect ecological risk for the broad groups consisting of raptors, small mammals, migratory birds, game mammals, game birds, soil fauna, and plants in the upland and wetland ecosystems.

7.2.3 Risk Characterization

The following sections describe the risk characterization for aquatic and terrestrial ecological risks.

7.2.3.1 Aquatic Ecological Risk Characterization

In the BARA (Weston, 1995b), the screening-level risk to aquatic receptors was characterized using the hazard quotient (HQ) approach wherein the exposure point concentration for each COC at each sampling station was divided by the specified toxicity value. An HQ value greater than one indicates some possibility that adverse effects may occur. However, an HQ greater than one does not indicate that an effect will definitely occur due to the conservative nature of the risk assessment.

For exposure of aquatic receptors to surface water the exposure point concentration was defined as the maximum observed concentration or the 95 percentile of the upper confidence level (UCL95) concentration for each COC at each station. The toxicity value was defined by the chronic and acute ambient water quality criteria (AWQC) established by the EPA or State of Colorado for protection of freshwater aquatic life. The BARA evaluated both historic (pre-Yak Tunnel Treatment Plant operation) and current (1992-1994) surface water quality data.

Hazard quotients (HQ) for the current surface water data were greater than one for zinc at most sampling stations in Lower California Gulch within OU8 for fall surface water data when compared to EPA acute AWQC. Based on spring water quality data, HQ values were greater than one for cadmium, copper, and zinc at most sampling stations in Lower California Gulch when compared to EPA acute AWQC. These HQ values indicate a potential risk to aquatic receptors exposed to surface water in Lower California Gulch within OU8. Surface water and sediments in Lower California Gulch were also identified as sources of metal contamination to the Arkansas River (Weston, 1995b). However, as previously described, the majority of metal loading to Lower California Gulch is contributed by sources upstream of OU8. Metal concentrations in surface water generally decrease downstream in Lower California Gulch within OU8.

7.2.3.2 Terrestrial Ecological Risk Characterization

The Terrestrial Ecological Risk Characterization (ERA) (Weston, 1997) assessed the potential for adverse affects on terrestrial receptors. The risk assessment was based on ingestion and direct contact exposure pathways to metals inherent in surface water, surface soils, slag, waste rock, tailing, fluvial tailing, and stream sediment. Specific terrestrial receptors were selected to represent exposure uptakes for the broad ecological groups in upland and riparian areas. The upland receptors were blue grouse, mountain bluebird, American kestrel, red-tailed hawk, bald eagle, least chipmunk, mule deer, and red fox. The wetland receptors were the belted kingfisher, spotted sandpiper, red-winged blackbird, and long-tailed vole. Plants and soil fauna were also evaluated for contact with the solid exposure media.

The baseline risk characterization conducted in the ERA (Weston, 1997) also utilized the HQ method. HQs were calculated for all COCs for each upland and wetland receptor on a station by station basis and also on an OU basis for upland receptors. The HQ is the ratio of the estimated exposure intake to the toxicity benchmark value for each receptor. Exposure intakes were estimated based on the maximum concentrations of media for each sampling station and the UCL95 concentration of media on an OU basis. The exposure intake for each OU was not

adjusted to reflect the spatial distribution and intensity of media sampling data or the frequency and duration of contact with contaminated media within each OU. The toxicity benchmark value was defined for each receptor as the no adverse effect level based on toxicological literature adjusted by an uncertainty factor. The toxicity benchmark values are intended to protect the most sensitive individuals and species and were not adjusted to reflect background metal concentrations or metal bioavailability. To summarize the HQ values, hazard indices (HI) were calculated by summing the HQ values for each exposure pathway and for all COCs.

The results of the ERA (Weston, 1997) indicate there is a potential risk to specific upland and wetland receptors within OU8. Within OU8, HQ values were greater than one for upland species consisting of blue grouse, mountain bluebird, American kestrel, and the least chipmunk. Ingestion of lead from surface soil, tailing, and fluvial tailing contributed the largest portion of the HI values for these species. Ingestion of cadmium and zinc from surface soils, tailing, fluvial tailing, and sediment also contributed to the HI values. Exposure to cadmium, lead and zinc were frequently the cause of hazard quotient exceedances in all media for all the OUs. Wetland species were evaluated by station and not by operable unit. Ingestion of lead and zinc from fluvial tailing was generally the primary cause of risk to wetland receptors within OU8. Based on these results, remedial action is warranted within OU8.

Remedial action alternatives evaluated in the FFS (SMI/TerraMatrix, 2000) were evaluated, in part, based on the predicted ability of the alternatives to reduce or eliminate the exposure pathways identified in the human health, aquatic, and terrestrial risk assessments.

7.3 SUMMARY OF RISKS/BASIS OF ACTION

Response action at OU8 is warranted to protect the environment from actual or threatened releases of pollutants or contaminants that may present an imminent and substantial endangerment.

8.0 REMEDIAL ACTION OBJECTIVES

The remedies outlined in this ROD are intended to be the final remedial actions for OU8. Preliminary qualitative RAOs were developed during the SFS (EPA, 1993) for impounded tailing, non-residential area soils, waste rock, fluvial tailing, and stream sediment. The RAOs of the remedies presented in this ROD are listed below.

The following RAOs were defined for impounded tailing:

- Control airborne transport of tailing particles;
- Control erosion of tailing materials and deposition into local water courses;
- Control leaching and migration of metals from tailing into surface water; and
- Control leaching and migration of metals from tailing into groundwater.

The following RAOs were defined for non-residential area soil:

- Control airborne transport of contaminated materials;
- Control erosion of soil materials and deposition into local water courses;
- Control leaching and migration of metals from soil into surface water;
- Control leaching and migration of metals from soil into groundwater; and
- Control contaminant exposure to animals and aquatic life.

The following RAOs were defined for waste rock:

- Control air and water erosion of waste rock materials from the source locations;
- Control leaching and migration of metals from waste rock into surface water; and
- Control leaching and migration of metals from waste rock into groundwater.

The following RAOs were defined for fluvial tailing and stream sediments:

- Control erosion of contaminated materials into local water courses;
- Control leaching and migration of metals from contaminated materials into surface water; and
- Control leaching and migration of metals from contaminated materials into groundwater.

The effectiveness of the remedial action alternatives were evaluated with respect to these RAOs. Remedial actions undertaken within OU8 are consistent with the RAOs and goals identified for the entire California Gulch Superfund Site.

9.0 DESCRIPTION OF ALTERNATIVES

A wide range of cleanup options were considered in the SFS (EPA, 1993). Some of the alternatives were eliminated during preliminary screening because they would not effectively address contamination, could not be implemented, or would have had excessive costs. Remedial action alternatives for OU8 that were retained after screening alternatives from the SFS for the impounded tailing, non-residential area soils, waste rock, fluvial tailing, and stream sediment were evaluated in the FFS. All of the alternatives were evaluated using the nine criteria required by the NCP and six additional performance criteria required by the WAMP as a part of the CD. This evaluation is described in the next section.

A brief description of the cleanup alternatives that were considered in the FFS for the OU8 impounded tailing, non-residential area soils, waste rock, fluvial tailing, and stream sediment (SMEI/TerraMatrix, 2000) is provided below.

9.1 IMPOUNDED TAILING

Impounded tailing was located at the CZL Tailing Impoundment. All tailing have been removed from the site. No other impounded tailing exist within OU8.

Alternative 1: No Further Action (Selected Alternative)

Estimated capital and operating cost: $0
Implementation time: Immediate

No additional remediation would take place under this alternative. Removal of the tailing achieved the RAOs, applicable or relevant and appropriate requirements (ARAR), and performance standards defined in the Action Memorandum.

9.2 NON-RESIDENTIAL AREA SOILS

The following two alternatives described below were analyzed for the non-residential area soils.

Alternative 1: Non-Residential Area Soils - No Further Action

Estimated capital and operating cost: $0
Implementation time: Immediate

No remediation would take place under this alternative. This alternative is presented as a baseline condition for comparison of Alternative 2.

Alternative 2: Containment (Selected Alternative)

Estimated capital and operating cost: $48,600
Implementation time: One to two years

This in-situ stabilization of contaminated soil alternative consists of (1) regrading to promote positive drainage, (2) establishing vegetation with soil amendments, as needed, with lime, nutrients, and organic matter, and (3) institutional controls. Approximately two of the 9.9 acres of non-residential area soils within OU8, would require remediation. Of the two-acre area, about one acre is wetland and would be revegetated with wetland species. The remaining area would be revegetated with upland species. Operations and maintenance (O&M) would involve inspection and maintenance of the vegetated areas. A portion of the Gaw Brewery (historical Site 5LK897) is located in the area that would be remediated; however, disturbance of the site during remediation activities would be avoided. Institutional controls such as deed notices or deed restrictions would be implemented to provide notification that a vegetation barrier is in place and to restrict land use to protect the integrity of the remedy. Modifications to County and/or City zoning ordinances would involve the creation of a zoning "overlay district" to provide a screening process to identify properties where special precautions or requirements may be necessary.

9.3 WASTE ROCK

The Gaw waste rock pile is located near Apache Tailing Impoundments (OU7). The following alternative described below was analyzed for the Gaw waste rock pile.

Alternative 1: No Further Action (Selected Alternative)

Estimated capital and operating cost: $0
Implementation time: Immediate

No Action is necessary since the FFS shows that the Gaw waste rock pile is not a source of metals contamination to surface water or groundwater and is not a source of risk to human health or the environment. The Gaw pile covers an area of approximately ½ acre and contains an estimated waste rock volume of approximately 7,500 cubic yards. The No Action alternative would take no action to alter or remediate current conditions at the Gaw waste rock pile.

9.4 FLUVIAL TAILING

Alternative 1: No Further Action

Estimated capital and operating cost: $0
Implementation time: Immediate

No remediation would take place under this alternative. This alternative is presented as a baseline condition for comparison of Alternative 2.

Alternative 2: Fluvial Tailing - Containment (Selected Alternative)

Estimated capital and operating cost: $987,700
Implementation time: One year

This alternative addresses areas of fair vegetation in wetland and upland areas and areas where fluvial tailing was previously removed. This stabilization alternative consists of (1) regrading, (2) revegetation, (3) riprap or erosion-control matting in erosion-prone areas of fluvial tailing, and (4) institutional controls. Of the approximately 60 acres of fluvial tailing in OU8, approximately 11.5 acres of wetland and 13.3 acres of upland have been identified for this alternative. Wetland areas would be revegetated with the same native wetland plant species that currently dominate the California Gulch wetlands. The upland areas would be regraded and vegetation established with soil amendments, as needed, with lime, nutrients, and organic matter. In addition, erosion-prone areas will be protected with riprap and a suitable filter fabric. Erosion-prone areas are directly adjacent to the California Gulch channel. Approximately 2,400 feet of channel would be reinforced. O&M would involve inspection and maintenance of the remediated areas. Institutional controls would be implemented as described in Non-residential Area Soils, Alternative 2.

9.5 STREAM SEDIMENT

The following three alternatives described below were analyzed for the stream sediments.

Alternative 1: Stream Sediment - No Further Action

Estimated capital and operating cost: $0
Implementation time: Immediate

No remediation would take place under this alternative. This alternative is presented as a baseline condition for comparison to Alternatives 2 and 3.

Alternative 2: Sediment Removal (Selected Alternative)

Estimated capital and operating cost: $711,000
Implementation time: One year

This alternative consists of (1) reconstruction of unstable braided channel areas of FTS3, (2) construction of a channel through FTS6, to convey the 500-year flood in California Gulch, (3) removal of sediment and channel improvements in currently erosionally unstable areas (adjacent to Arkansas Valley Slag Pile and downstream of the Cloud City Ski Club), and (4) institutional controls. Channel reconstruction consists of a riprap-lined channel designed to convey and be stable for the 500-year flood or a riprap-lined pilot channel with an erosion resistant overbank designed to be stable during the 500-year flood. O&M would involve inspection and maintenance of the remediated areas. Institutional controls would be implemented as described in Non-Residential Area Soils, Alternative 2.

Alternative 3: Stream Sediment - Complete Sediment Removal

Estimated capital and operating cost: $4,880,000
Implementation time: Two years

This alternative consists of (1) removal of sediment throughout the length of the existing California Gulch channel within OU8, and (2) reconstruction of the channel. Sediment removal would occur throughout the approximate 4.3-mile length and result in approximately 33,350 cubic yards of sediment and soil being removed. Channel reconstruction consists of a riprap-lined pilot channel with erosion resistant overbank designed to be stable during the 500-year flood.

10.0 SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

Section 300.430(e)(9) of the NCP requires that the EPA evaluate and compare the remedial cleanup alternatives based on the nine criteria listed below. The first two criteria, (1) overall protection of human health and the environment and (2) compliance with applicable or relevant and appropriate requirements (ARAR), are threshold criteria that must be met for the Selected Remedies. The Selected Remedies must then represent the best balance of the remaining primary balancing and modifying criteria. In addition, the cleanup alternatives were evaluated using six performance criteria specified in the WANP (USDC, 1994) to assist in evaluating the effectiveness of each alternative.

10.1 NCP EVALUATION AND COMPARISON CRITERIA

The following sections describe the NCP evaluation and comparison criteria.

10.1.1 Threshold Criteria

1. Overall protection of human health and the environment address whether each alternative provides adequate protection of human health and the environment and describes how risks posed through each exposure pathway are eliminated, reduced, or controlled, through treatment, engineering controls, and/or Institutional Controls.

2. Compliance with ARARs addresses whether or not a remedy will comply with identified federal and state environmental and citing laws and regulations.

10.1.2 Primary Balancing Criteria

3. Long-term effectiveness and permanence refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once clean-up levels have been met. This criterion includes the consideration of residual risk that will remain on site following remediation and the adequacy and reliability of controls.

4. Reduction of toxicity, mobility, and volume through treatment refers to the anticipated performance of the treatment technologies that may be included as part of a remedy.

5. Short-term effectiveness addresses the period of time needed to complete the remedy and any adverse impact on human health and the environment that may be posed during the construction and implementation period until cleanup goals are achieved.

6. Implementability refers to the technical and administrative feasibilities of a remedy, including the availability of materials and services needed to carry out a particular option.

7. Cost evaluates the estimated, capital costs, O&M costs, and present worth costs of each alternative.

10.1.3 Modifying Criteria

8. State acceptance indicates whether the State (CDPHE), based on its review of the information, concurs with, opposes, or has no comment on the preferred alternative.

9. Community acceptance is based on whether community concerns are addressed by the Selected Remedy and whether or not the community has a preference for a remedy.

10.2 WAMP PERFORMANCE CRITERIA

Additional site-specific criteria beyond the required NCP criteria have been developed for evaluating remedial alternatives for OU8. These criteria are described in the WAMP attached as Appendix D to the Consent Decree for the California Gulch Site (USDC, 1994). The six WAMP criteria listed below assisted in the evaluation of the effectiveness of each proposed alternative:

1. Surface Erosion Stability: Remedial alternatives for source material will ensure surface erosion stability through the development of surface configurations and implementation of erosion protection measures.

2. Slope Stability: Source remediation alternatives will ensure geotechnical stability through the development of embankments or slope contours.

3. Flow Capacity and Stability: Remedial alternatives utilizing retaining structures, diversion ditches, or reconstructed stream channels will ensure sufficient capacity and erosional stability of those structures.

4. Surface and Groundwater Loading Reduction: Remedial alternatives will ensure reduction of mass loading of COCs (including TSS and sulfate), and change in pH, resulting from run-on, run-off, and infiltration from source areas.

5. Terrestrial Ecosystem Exposure: Evaluation of remedial action alternatives with respect to reduction of risk to the terrestrial ecosystems within each OU should be based on area-wide estimates of risk to receptor populations.

6. Non-residential Soils: Non-residential soils will be addressed in the FFS consistent with current and likely future land use.

All remedial designs will be performed to meet the six WAMP performance criteria.

10.3 EVALUATING THE ALTERNATIVES WITH THE NCP CRITERIA

This section summarizes the evaluation of the Lower California Gulch impounded tailing, non-residential area soils, waste rock, fluvial tailing, and stream sediment alternatives against the nine NCP criteria. The following subsections are a brief summary of the evaluation and comparison of the Lower California Gulch alternatives against each criteria. Additional details of the evaluation of the alternatives are presented in the FFS. Tables 5 and 6 provide a comparison of the nine

remedial action alternatives and the nine NCP criteria. Information for this section was obtained from the FFS for Lower California Gulch (OU8) (SMI/TerraMatrix, 2000).

10.3.1 Overall Protection of Human Health an the Environment

This criterion is based on the level of protection of human health and the environment afforded by each criteria.

IMPOUNDED TAILING

As previously discussed, the CZL Tailing Impoundment was removed in 1995 pursuant to an Action Memorandum. Removal of the tailing achieved the RAOs for impounded tailing, met the ARARs, and is protective of human health and environment. The No Action alternative would maintain the post-removal action conditions at the CZL Tailing Impoundment site. No other impounded tailing exist within OU8.

NON-RESIDENTIAL AREA SOILS

Alternative 1 (No Action) would not achieve RAOs and would not be protective of human health and the environment. Alternative 2 (containment) would achieve the RAOs by reducing the potential for leaching and migration of metals from non-residential area soils in fair and poorly vegetated areas to surface water and groundwater. Surface waster and groundwater metal loading were estimated to be reduced by 47 and 55 percent, respectively. Airborne transport, erosion and deposition of soil from currently unvegetated areas would be significantly reduced by a stable vegetated cover. In addition, the vegetated cover would reduce injestion of non-residential area soils to terrestrial receptors. Therefore, Alternative 2 would be protective of human health and the environment.

WASTE ROCK

Waste rock contained within the Gaw pile was not identified as a source of risk to human health or the environment. Erosion of waste rock from the pile is controlled by existing conditions. Alternative 1 (No Action) would not alter the existing conditions at the Gaw pile. Current conditions at the pile achieve the RAOs defined for waste rock and are protective of human health and the environment.

FLUVIAL TAILING

Alternative 1 (No Action) would not achieve RAOs and would not be protective of human health and the environment because there would be no change to the existing condition. Alternative 2 (containment) would achieve the RAOs by reducing the potential for erosion and the potential for leaching of metals and, thus, would be protective of human health and the environment. Surface water and groundwater metal loading were estimated to be reduced by 77 percent for Alternative 2 (based on conditions prior to the interim removal action).

STREAM SEDIMENT

Alternative 1 (No Action) would not achieve RAOs and would not be protective of human health and the environment because the no action would not alter any present risk to the environment. Alternative 2 (sediment removal and channel reconstruction in FTS3 and FTS6) and Alternative 3 (complete sediment removal and channel reconstruction) would achieve the RAOs and would be protective of human health and the environment by reducing the downstream erosion of existing sediments and the potential for leaching of metals from existing sediments. In addition, Alternative 3 would eliminate erosion and the potential for leaching of metals because the contaminated sediment would be removed. Neither Alternatives 2 or 3 would prevent the introduction of sediment from upstream sources into OU8.

10.3.2 Compliance with Applicable or Relevant and Appropriate Requirements

This criterion is based on compliance with the ARARs presented in Tables 7 through 9.

IMPOUNDED TAILING

Alternative 1 (no action) complies with all ARARs because impounded tailing has been removed.

NON-RESIDENTIAL AREA SOILS

Alternative 1 would not comply with ARARs. Alternative 2 would comply with potential ARARs.

WASTE ROCK

Alternative 1 (no action) would comply with ARARs.

FLUVIAL TAILING

Alternative 1 would not comply with ARARs because no action would take place. Alternative 2 would comply with all ARARs.

STREAM SEDIMENT

Alternative 1 would not comply with ARARs because no action would take place. Alternative 2 would comply with all ARARs. However, Alternative 2 would produce short-term disturbance to existing wetlands in specific areas. Alternative 3 would comply with all ARARs However, Alternative 3 would produce extensive short-term disturbance to existing floodplain and wetlands would result, wetland mitigation may be required, and net reduction in wetland areas may occur.

10.3.3 Long-term Effectiveness and Permanence

This criterion is based on compliance with long-term effectiveness and permanence.

IMPOUNDED TAILING

Excellent long-term effectiveness and permanence because the impounded tailing have already been removed from the CZL Tailing Impoundment site and no other impounded tailing exist within OU8.

NON-RESIDENTIAL AREA SOILS

Alternative 1 (No Action) would provide little or no long-term effectiveness and permanence because there would be no change from existing condition. Alternative 2 would provide a greater level long-term effectiveness and permanence by establishing positive surface drainage and a self-sustaining vegetated cover.

WASTE ROCK

Erosion of waste rock from the pile is controlled by existing conditions. Leaching of metals from the waste rock was not detected. The existing conditions at the Gaw waste rock pile presents a permanent solution. Alternative 1 (No Action) would not after the existing conditions at the Gaw waste rock pile.

FLUVIAL TAILING

Alternative 1 (No Action) would provide little or no long-term effectiveness and permanence because there would be no change from existing conditions. Alternative 2 would provide a much greater level of long-term effectiveness and permanence by establishing positive surface drainage and a self-sustaining vegetated cover.

STREAM SEDIMENT

Alternative 1 (No Action) would provide little or no long-term effectiveness and permanence because there would be no change from existing conditions. Alternatives 2 and 3 would both provide a high level of long-term effectiveness, although Alternative 3 would provide more protection and permanence because all the contaminated stream sediment would be removed. Neither Alternative 1, 2, or 3 would prevent introduction of sediment from upstream areas into OU8.

10.3.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

This criterion is based on the treatment process used; the amount of contamination destroyed or treated; the reduction of toxicity, mobility, or volume through treatment; the irreversible nature of the treatment; the type and quantity of residuals remaining; and the statutory preference for treatment.

IMPOUNDED TAILING

Treatment is not applicable because the tailing have been previously removed.

NON-RESIDENTIAL AREA SOILS

Neither Alternative 1 or 2 includes treatment.

WASTE ROCK

Treatment is not applicable because the waste rock pile within the Gaw pile was not identified as a source of risk to human health or the environment.

FLUVIAL TAILING

Neither Alternative 1 or 2 includes treatment.

STREAM SEDIMENT

Neither Alternative 1, 2, or 3 includes treatment.

10.3.5 Short-term Effectiveness

This criterion is based on the degree of community and worker protection offered, the potential environmental impacts of the remediation, and the time until the remedial action is completed.

IMPOUNDED TAILING

Excellent short-term effectiveness because no activities would be required for Alternative 1 (No Further Action).

NON-RESIDENTIAL AREA SOILS

There would be no change in existing conditions in Alternative 1 (No Action) and, thus, no disturbance. Alternative 2 would have minimal disturbance during implementation and slight potential for short-term risk due to dust emissions. However, fugitive dust emissions would be controlled by standard construction practices.

WASTE ROCK

In Alternative 1 (No Action), there would no disturbance to the community or to the environment since no action would take place.

FLUVIAL TAILING

In Alternative 1 (No Action), there would no disturbance to the community or to the environment since no action would take place. There would be minimal disturbance and some short-term risk during implementation of Alternative 2 due to increased traffic and potential for dust generation during remediation activities. However, fugitive dust emissions would be controlled by standard construction practices.

STREAM SEDIMENT

In Alternative 1 (No Action), there would no disturbance to the community or to the environment since no action would take place. There would be minimal short-term risk for Alternative 2 due to increased traffic, dust emissions, and release of sediment during remediation activities. However, fugitive dust emissions would be controlled by standard construction practices. Also, disturbance of existing floodplain and wetland areas would result from implementation of Alternative 2. Alternative 3 would have additional short-term risks compared to Alternative 2 because of the additional remediation activities. Moreover, extensive short-term disturbance to existing wetland and floodplain areas in Alternative 3 would require mitigation of the wetlands.

10.3.6 Implementability

This criterion is based on the ability to perform construction and implement administrative actions.

IMPOUND TAILING

Alternative 1 would be easy to implement since no action is required.

NON-RESIDENTIAL AREA SOILS

Alternative 1 would be easy to implement since no action is required. Alternative 2 would be relatively easy to implement and could be performed in one construction season with conventional construction equipment. Lake County and the City of Leadville have agreed to implement the institutional controls in the form of the "overlay district."

WASTE ROCK

Alternative 1 would be easy to implement since no action is required.

FLUVIAL TAILING

Alternative 1 would be easy to implement since no action is required. Alternative 2 would be relatively easy to implement and could be performed in one construction season with conventional construction equipment. Lake County and the City of Leadville have agreed to implement the institutional controls in the form of the "overlay district."

STREAM SEDIMENT

Alternative 1 would be easy to implement since no action is required. Alternative 2 would require effort to perform sediment removal and channel reconstruction in specific areas and would require land owner consent to implement the remediation activities on private property. Alternative 3 would be more difficult to implement compared to Alternative 2 because of the additional remediation activities for complete sediment removal and channel reconstruction. Lake County

and the City of Leadville have agreed to implement the institutional controls in the form of the "overlay district."

10.3.7 Cost

This criterion evaluates the estimated capital, O&M, and present worth costs of each alternative.

IMPOUNDED TAILING

There would be no cost associated with Alternative 1.

NON-RESIDENTIAL AREA SOILS

No direct cost is associated with Alternative 1. The present worth cost of Alternative 2 is estimated at approximately $107,000.

WASTE ROCK

There would be no cost associated with Alternative 1.

FLUVIAL TAILING

No direct cost is associated with Alternative 1. The present worth cost to implement Alternative 2 is estimated at approximately $1.5 million.

STREAM SEDIMENT

No direct cost is associated with Alternative 1. The present worth cost to implement Alternative 2 is estimated at approximately $792,000 compared to $5.86 million for Alternative 3.

10.3.8 State Acceptance

The State has been consulted throughout this process and concurs with EPA's selected alternatives.

10.3.9 Community Acceptance

Public comment on the RI/FS and Proposed Plan was solicited during a formal public comment period extending from July 27 to August 28, 2000. The following EPA selected alternatives were presented:

Impounded Tailing:	Alternative 1 - No Further Action
Non-Residential Area Soils:	Alternative 2 - Containment
Waste Rock:	Alternative 1 - No Action

Fluvial Tailing:	Alternative 2 - Containment
Stream Sediment:	Alternative 2 - Sediment Removal and Channel Reconstruction in Fluvial Tailing Site 3 and Fluvial Tailing Site 6

No comments from the community were received during the formal comment period.

11.0 PRINCIPAL THREAT WASTES

The NCP establishes an expectation that EPA will use treatment to address the principal threats posed by the site wherever practicable (NCP §300.430(a)(1)(iii)(A)). Identifying principal threat wastes combines concepts of both hazard and risk. In general, principal threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be contained in a reliable manner or would present a significant risk to human health or the environment should exposure occur. Conversely, non-principal threat Wastes are those source materials that generally can be reliably contained and that would present only a low risk in the event of exposure. The manner in which principal threats are addressed generally will determine whether the statutory preference for treatment as a principal element is satisfied.

The source materials identified at the OU8 site include impounded tailing, non-residential area soils, waste rock, fluvial tailing, and stream sediment. These source materials do not constitute principal threat wastes; hence, they are considered non-principal threat wastes. Removal, containment, and implementation of institutional controls of the source materials are reliable remedies.

12.0 SELECTED REMEDY

Pursuant to an Action Memorandum issued by EPA (EPA, 199 5), the CZL Tailing Impoundment was addressed by an interim removal action. This interim removal action was based on an Engineering Evaluation/Cost Analysis (EE/CA), which was preformed to identify potential removal actions for the CZL Tailing Impoundment and adjoining portions of FTS2. Approximately 28,000 cubic yards of material were excavated from the CZL Tailing Impoundment, the western portion of FTS2, and the underlying foundation soils and placed on the Oregon Gulch Tailing Impoundment (OU10). The excavated area was backfilled with clean borrow soil, graded, and vegetated. Wetlands adjacent to the CZL Tailing Impoundment site were vegetated in the summer of 1996.

In addition, an Action Memorandum was issued by EPA in June 1998 that selected the interim removal actions for fluvial tailing and stream sediment. This Action Memorandum was based on the *Draft Focused Feasibility Study for Lower California Gulch, Operable Unit 8* (SMI/TerraMatrix, 1997) and the *Final Removal Action Planfor Selected Fluvial Tailing and Stream Sediment* (SMI/TerraMatrix, 1998). The interim removal actions are consistent with the alternatives for the remediation of fluvial tailing and contaminated stream sediment evaluated in the FFS. The following interim removal actions were performed in conjunction with the planned remedial action in Oregon Gulch, OU10.

- Approximately 5,794 cubic yards of fluvial tailing were excavated from poorly vegetated, erosion-prone areas within OU8 (specifically, FTS2, FTS3, FTS6, and FTS8). The excavated tailing was transported and placed on the Oregon Gulch Tailing Impoundment (OU10).

- In conjunction with channel excavation, approximately 1,339 cubic yards of sediment were removed from accumulated sediment in FTS3 and FTS2. The excavated stream sediment was transported and placed on the Oregon Gulch Tailing Impoundment (OU10).

12.1 RATIONALE FOR SELECTED REMEDY

Based upon consideration of the requirements for CERCLA and the NCP, the detailed analysis of alternatives, and public comments, EPA has determined the following alternatives are the appropriate remedies for impounded tailing, non-residential area soils, waste rock, fluvial tailing, and stream sediment located within OU8:

Impounded Tailing:	Alternative 1 - No Further Action
Non-Residential Area Soils:	Alternative 2 - Containment
Waste Rock:	Alternative 1 - No Action
Fluvial Tailing:	Alternative 2 - Containment

Stream Sediment:	Alternative 2 - Sediment Removal and Channel Reconstruction in Fluvial Tailing Site 3 and Fluvial Tailing Site 6

These Selected Remedies will be protective of human health and the environment and meet RAOs described earlier through the following:

- Provides the highest level of performance and long-term effectiveness.
- Meets or exceeds all of the stability requirements predicated in the WAMP and reduces the present risk to the terrestrial ecosystem.
- Reduces the potential for erosion and leaching of metals and controls contaminant exposure to animals and aquatic life.
- Reduces or controls the risks defined by the risk assessment including ingestion of non-residential area soils, fluvial tailing, and stream sediment by terrestrial wildlife.

These Selected Remedies best meet the entire range of selection criteria and achieve, in EPA's determination, the appropriate balance considering site-specific conditions and criteria identified in CERCLA, the NCP, and the WAMP, as provided in Section 13.0, Statutory Determinations.

12.2 DESCRIPTION OF SELECTED REMEDIES

Detailed descriptions of the Selected Remedies for impounded tailing, non-residential area soils, waste rock, fluvial tailing, and stream sediment within OU8 are discussed below.

12.2.1 Remedy for Impounded Tailing

The Selected Remedy for impounded tailing will provide no further action. Impounded tailing was located at the CZL Tailing Impoundment but all tailing have been removed from the site in 1995 during an interim removal action. No other impounded tailing exist within OU8.

12.2.2 Remedy for Non-Residential Area Soils

The Selected Remedy for non-residential area soils consists of (1) regrading to promote positive drainage, (2) establishing vegetation with soil amendments, as needed, with lime, nutrients, and organic matter, and (3) institutional controls. Approximately two of the 9.9 acres of non-residential area soils within OU8, will require remediation. Of the two-acre area, about one acre is wetland and will be revegetated with wetland species. The remaining area will be revegetated with upland species. A portion of the Gaw Brewery (historical Site 5LK897) is located in the area that will be remediated; however, disturbance of the site during remediation activities will be avoided.

Institutional controls designed to provide notification that a barrier is in place and to restrict land use to protect the integrity of the remedy. Modifications to County and/or City zoning ordinances

that involve the creation of a zoning "overlay district" to provide a screening process to identify properties where special precautions or requirements will be necessary.

An O&M program will be developed during the remedial design. O&M activities will involve inspection and maintenance of the vegetation cover. At a minimum, inspection of the site will include evidence of erosion and vegetation monitoring.

12.2.3 Remedy for Waste Rock

No Action is necessary since the FFS shows that the Gaw waste rock pile is not a source of metals contamination to surface water or groundwater and is not a source of risk to human health or the environment. The Gaw pile covers an area of approximately ½ acre and contains an estimated waste rock volume of approximately 7,500 cubic yards. The No Action alternative will take no action to alter or remediate current conditions at the Gaw waste rock pile.

12.2.4 Remedy for Fluvial Tailing

The Selected Remedy for fluvial tailing addresses areas of fair vegetation in wetland and upland areas and areas where fluvial tailing were previously removed. This remedy involves (1) regrading, (2) revegetation, (3) riprap or erosion-control matting in erosion-prone areas of fluvial tailing, and (4) institutional controls. Of the approximately 60 acres of fluvial tailing in OU8, approximately 11.5 acres of wetland and 13.3 acres of upland have been identified for this alternative. Wetland areas would. be revegetated with the same native wetland plant species that currently dominate the California Gulch wetlands. The upland areas will be regraded and vegetation established with soil amendments, as needed, including lime, nutrients, and organic matter. In addition to regrading and erosion-prone areas will be protected with riprap and a suitable filter fabric. Erosion-prone areas are directly adjacent to the California Gulch channel. Approximately 2,400 feet of channel would be reinforced.

Institutional controls designed to provide notification that a barrier is in place and to restrict land use to protect the integrity of the remedy. Modifications to County and/or City zoning ordinances that involve the creation of a zoning "overlay district" to provide a screening process to identify properties where special precautions or requirements will be necessary.

An O&M program will be developed during the remedial design. O&M activities will involve inspection and maintenance of the vegetated cover. At a minimum, inspection of the site will include evidence of erosion and vegetation monitoring.

12.2.5 Remedy for Stream Sediment

The Selected Remedy for stream sediment consists of (1) reconstruction of unstable braided channel areas of FTS3, to convey the 500-year flood in California Gulch, (2) construction of a channel through FTS6, (3) removal of sediment and channel improvements in currently erosionally unstable areas (adjacent to Arkansas Valley Slag Pile and downstream of the Cloud City Ski Club), and (4) institutional controls.

In FTS3, California Gulch flow is divided into a north and south channel, with most of the flow being conveyed in the north channel. A channel will be constructed to divert flow from the existing north channel to the south channel. The reconstructed channel will begin at the north channel approximately 150 feet downstream of County Road 6, will traverse to the south channel, and then continue to the downstream end of FTS3. Channel reconstruction consists of a riprap-lined channel designed to convey and be stable for the 500-year flood or a riprap-lined pilot channel with an erosion resistant overbank designed to be stable during the 500-year flood.

Adjacent to FTS6, the existing California Gulch channel is elevated on the northeast-facing slope above FTS6 to allow flows to be conveyed through the southern boundary of the Apache Tailing Impoundments (OU7). With this alternative, this existing channel will be abandoned. A channel will be constructed through FTS6 for a length of approximately 1,000 feet in the approximate location of the historical California Gulch channel. The reconstructed channel will convey flow from the outlet of the stilling basin of the California Gulch channel in OU1 to the Apache Tailing Impoundments.

In the reach adjacent to the Arkansas Valley Smelter site (OU5), the existing California Gulch channel is located immediately northwest of Highway 24. The channel is confined on the northwest by a soil berm for a length of approximately 1,000 feet. During high flows of 1995 and 1996, soil eroded-from this berm was transported downstream and deposited in FTS8 constricting the California Gulch channel. Channel enhancements in this, reach will consist of regrading the berm by flattening the berm sides to 2.5:1 and armoring the existing berm with riprap.

A 700-foot long reach of the California Gulch channel downstream of the Cloud City Ski Club is confined on the north side by a soil berm. During high flows in 1995 and 1996, this berm was breached in several areas and soil eroded from this berm was transported downstream. The flow in California Gulch is constricted with sediment in several areas downstream of this reach. Channel enhancements in this reach will consist of regrading the existing berm by flattening the berm sides to 2.5:1 and armoring the berm with riprap.

Institutional controls designed to provide notification that a barrier is in place and to restrict land use to protect the integrity of the remedy. Modifications to County and/or City zoning ordinances that involve the creation of a zoning “overlay district” to provide a screening process to identify properties where special precautions or requirements will be necessary.

An O&M program will be developed during the remedial design. O&M activities will involve inspection and maintenance of the remediated areas. At a minimum, inspection of the site will include an evaluation for any evidence of erosion and other possible problems of erosion.

A long-term monitoring program will also be developed during the remedial design for surface water and groundwater monitoring for the performance of the Selected Remedy as described in the Selected Remedy for Non-Residential Area Soils.

12.3 ESTIMATED REMEDY COSTS

There are no additional costs associated with waste rock or impounded tailing.

The detailed cost estimate and present worth analysis for the Selected Remedy for non-residential area soils are presented in Table 10. The net present value of the estimated capital and operating cost for a 30 year period is approximately $107,000. The time frame to implement the remedy is anticipated to be one to two years.

The detailed cost estimate and present worth analysis for the Selected Remedy for fluvial tailing are presented in Table 11. The net present value of the estimated capital and operating cost for a 30 year period is approximately $1.5 million. The time frame to implement the remedy is anticipated to be one year.

The detailed cost estimate and present worth analysis for the Selected Remedy for stream sediment are presented in Table 12. The net present value of the estimated capital and operating cost for a 30 year period is approximately $1.5 million. The time frame to implement the remedy is anticipated to be one to two years.

The information in these cost estimate tables are based on the best available information regarding the anticipated scope of the remedial alternatives. Changes in the cost elements are likely to occur as a result of new information and. data collected during the engineering design of the remedial alternatives. Major changes may be documented in the form of a memorandum in the Administrative Record file, an Explanation of Significant Difference, or a ROD amendment. This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the actual project cost.

12.4 EXPECTED OUTCOME OF THE SELECTED REMEDY

The Selected Remedies for OU8 would make the the non-residential area soils and the fluvial tailing areas with a vegetated cover a permanent waste management area. Exposure of source materials would be controlled through the use of engineering and institutional controls only. The anticipated environmental and ecological benefits would help restore the quality of groundwater and environmental conditions in California Gulch, minimize surface water impacts during storm events, and eliminate direct contact to humans and fauna.

13.0 STATUTORY DETERMINATIONS

Under CERCLA Section 121, EPA must select a remedy that is protective of human health and the environment; that complies with ARARs; is cost effective; and utilizes permanent solutions, alternative treatment technologies, or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that includes treatment which permanently and significantly reduces the volume, toxicity, or mobility of hazardous wastes as a principal element. The Selected Remedies do not satisfy the statutory preference for treatment as a principal element of the remedy. In narrowing the focus of the FFS, treatment of the Lower California Gulch (OU8) was determined to be technically and economically impracticable. The following sections discuss how the Selected Remedies meet statutory requirements. A similar determination was made in selecting the interim removal actions as presented in the two Action Memorandums (EPA, 1995 and EPA, 1998).

13.1 PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The following section summarizes the estimated effectiveness of the Selected Remedies for the impounded tailing, non-residential area soils, waste rock, fluvial tailing, and stream sediment within OU8 for the protection of human health and the environment.

Impounded Tailing: Alternative 1 - No Further Action

The Selected Remedy protects human health and the environment because no threats to human health or the environment are currently associated with the CZL Tailing Impoundment since all the tailing have been removed during the 1995 interim removal action.

Non-Residential Area Soils: Alternative 2 - Containment

The Selected Remedy protects human health and the environment through reduction of airborne transport, erosion, and deposition of soil by a stable vegetated cover. Infiltration through the non-residential area soils would be reduced by eliminating ponded water and increasing evapotranspiration through vegetation. Surface water and groundwater loading were estimated to be reduced by 47 and 55 percent, respectively. The potential for leaching and migration of metals from non-residential area soils in fair and poorly vegetated areas to surface water and groundwater would be reduced. The vegetated cover would reduce ingestion of non-residential area soils to terrestrial receptors.

Waste Rock: Alternative 1 - No Action

No threats to human health or the environment are currently associated with the Gaw pile.

Fluvial Tailing: Alternative 2 - Containment

The Selected Remedy protects human health and the environment through reduction erosion and transport of soil by a stable vegetated cover. Infiltration through the fluvial tailing would be reduced by eliminating ponded water and increasing evapotranspiration through vegetation.

Surface water and groundwater metal loading were estimated to be reduced by 77 percent for Alternative 2 (based on conditions prior to the interim removal action). The potential for leaching and migration of metals from fluvial tailing to surface water and groundwater would be reduced.

Stream Sediment: Alternative 2 - Sediment Removal and Channel Reconstruction in Fluvial Tailing Site 3 and Fluvial Tailing Site 6

The Selected Remedy protects human health and the environment through removal of stream sediments in defined reaches and reconstruction of the channel. Based on monitoring data, no metal loading to surface water or groundwater could be attributed to leaching of metals from stream sediment. Therefore, the existing loading and reduction in loading could not be quantified. However, the Selected Remedy would reduce any potential for leaching of metals from existing sediment.

13.2 COMPLIANCE WITH ARARs

The Selected Remedy will comply with all ARARs identified in Tables 7, 8, and 9. No waiver of ARARs will be necessary. Final performance standards will not include ARARs for Site-wide Surface Water and Groundwater or require a specified decrease in point or nonpoint source loadings of COCs to Site-wide Surface Water and Groundwater (USCD, 1994). It was agreed that the decision on remediation of Site-wide Water Quality (OU12) would be made between the EPA and the PRPs and memorialized in the CD only after remedies for source remediation were selected and implemented at each OU. As a result, specific water quality goals for surface streams and groundwater have not been established at this time.

13.3 COST EFFECTIVENESS

EPA has determined that the Selected Remedies are cost effective in mitigating the principal risks posed by contaminated non-residential area soils, fluvial tailing, and stream sediment. Section 300.430(f)(ii)(D) of the NCP requires evaluation of cost effectiveness. Overall effectiveness is determined by the following three balancing criteria: long-term effectiveness and permanence; reduction of toxicity, mobility, and volume through treatment; and short-term effectiveness. Overall effectiveness is then compared to cost to ensure that the remedy is cost effective. The Selected Remedies meet the criteria and provide for overall effectiveness in proportion to their cost. Specific cost estimates for all of the Selected Remedies include the following:

Impounded Tailing Alternative 1:	$	0
Non-Residential Area Soils Alternative 2:	$	107,000
Waste Rock Alternative 1:	$	0
Fluvial Tailing Alternative 2:	$	1,510,000
Stream Sediment Alternative 2:	$	792,000

The estimated cost for the Selected Remedy is $2.4 million. The cost estimate includes annual inspection.

To the extent that the the estimated cost of the Selected Remedies exceeds the cost for other alternatives, the difference in cost is reasonable when related to the greater overall effectiveness achieved by the Selected Remedies.

13.4 UTILIZATION OF PERMANENT SOLUTIONS AND ALTERNATIVE TREATMENT TECHNOLOGIES (OR RESOURCE RECOVERY TECHNOLOGIES) TO THE MAXIMUM EXTENT POSSIBLE

EPA has determined that the Selected Remedies represent the maximum practicable extent to which permanent solutions can be utilized in a cost effective manner at the OU8. Of those alternatives that are protective of human health and the environment and comply with ARARs, EPA has determined that the Selected Remedies for OU8 provide the best balance in terms of long-term effectiveness and permanence, treatment, implementability, cost, and state and community acceptance.

While the Selected Remedies for the impounded tailing, non-residential area soil, waste rock, fluvial tailing, and stream sediment do not utilize treatment or removal (except partial removal for sediment), the use of engineered covers and institutional controls provide a long-term effective and permanent barrier to contaminated waste materials, thus, reducing risk to a near equivalent extent.

13.5 PREFERENCE FOR TREATMENT AS A PRINCIPAL ELEMENT

Various treatment options for impounded tailing were considered early in the FS process; however, due to the nature and size of the impounded tailing, non-residential area soils, waste rock, fluvial tailing, and stream sediment, these options were determined to be either technically impracticable and/or not cost-effective (EPA, 1993).

13.6 FIVE-YEAR REVIEW REQUIREMENTS

Because waste material in Lower California Gulch (OU8) will remain on site, the Selected Remedy will require a five-year review under Section 121(c) of CERCLA and Section 300.430(f)(4)(ii) of the NCP. The five-year review includes a review of all monitoring, inspection of the integrity of the vegetative covers, and an evaluation as to how well the Selected Remedies are achieving the RAOs and ARARs that they were designed to meet.

14.0. DOCUMENTATION OF SIGNIFICANT CHANGES

The Selected Remedies are the third response actions to be taken at OU8 of the California Gulch Superfund Site. The first interim removal action implemented the Action Memorandum (EPA, 1995) for removal of CZL Tailing Impoundment. The second interim removal action implemented the Action Memorandum (EPA, 1998) for removal of fluvial tailing and stream sediment. These two interim removal actions were consistent with the Selected Remedies for OU8.

The Proposed Plan for the Lower California Gulchs was released for public comment on July 27, 2000. The Proposed Plan identified the following alternatives as the preferred alternatives for impounded tailing non-residential area soils, waste rock, fluvial tailing, and stream sediment within OU8:

Impounded Tailing:	Alternative 1 - No Further Action
Non-Residential Area Soils:	Alternative 2 - Containment
Waste Rock:	Alternative 1 - No Action
Fluvial Tailing:	Alternative 2 - Containment
Stream Sediment:	Alternative 2 - Sediment Removal and Channel Reconstruction in Fluvial Tailing Site 3 and Fluvial Tailing Site 6

No comments were received during the public comment period. Subsequently, the EPA determined that no significant changes to the remedies, as they were originally identified in the Proposed Plan, were necessary or appropriate.

15.0 REFERENCES

Camp Dresser and McKee, Inc. (CDM). 1994. *Soils Investigation Data Report, California Gulch CERCLA Site, Leadville, Colorado.* July.

Colorado Department of Law (CDL). 1986. *Yak Tunnel/California Gulch Remedial Investigation, Leadville, Colorado.* Prepared by Engineering-Science, Inc. February.

Golder and Associates, Inc. (Golder). 1996a *Final Surface Water Remedial Investigation Report, California Gulch Site, Leadville, Colorado.* May.

Golder. 1996b. *Final Hydrogeologic Remedial Investigation Report, California Gulch Site, Leadville, Colorado.* May.

P-III Associates, Inc. (P-III). 1997. *Cultural Resource Inventory of Portions of Operable Unit 8 of the California Gulch CERCLA Site, Lake County, Colorado.* Cultural Resources Report 5071-01-9604. July 9.

Sheppard Miller, Inc. and TerraMatrix, Inc. (SMI/TerraMatrix). 1995a. *Draft Operable Units 4, 8, and 10 Reconnaissance Report.* March.

SMI/TerraMatrix. 1995b, *Final Engineering Evaluation/Cost Analysis, Colorado Zinc-Lead Tailing Area within Lower California Gulch - Operable Unit 8, California Gulch Superfund Site, Leadville, Colorado.* Prepared for Resurrection Mining Company. July.

SMI/TerraMatrix. 1997. Draft Focused Feasibility Study for Lower California Gulch Operable Unit 8, California Gulch Site. Prepared for Resurrection Mining Company. September.

SMI/TerraMatrix. 1998. *Removal Action Plan for Selected Fluvial Tailing and Stream Sediment in Operable Unit 8.* Prepared for Resurrection Mining Company. April 15.

SMI/TerraMatrix. 2000. *Final Focused Feasibility Study for Lower California Gulch Operable Unit 8, California Gulch Site.* Prepared for Resurrection Mining Company.

U.S. Department of Commerce 1990. *Selected Population and Housing Characteristics.* Bureau of the Census.

U.S. District Court (USDC), District of Colorado. 1994. *Civil Action No. 83-C-2388, Consent Decree with ASARCO, Inc., Resurrection Mining Company, Newmont Mining Corporation, and the Res-ASARCO Joint Venture, Appendix D: Work Area Management Plan for the California Gulch Superfund Site, Implemented by Resurrection Mining Company.* August 26.

U.S. Environmental Protection Agency (EPA). 1987. *Phase I Remedial Investigation Report, California Gulch, Leadville, Colorado.* 53-8129.01W63781.Rl Prepared by CH2M Hill, Black & Veatch, ICF, PRC, and Ecology and Environment. May.

EPA. 1989. *Phase II Remedial Investigation Report, Technical Memorandum. Draft. California Gulch, Leadville, Colorado.* Vols. I-VI. 53-8129.01/DEN63786.Rl Prepared by CH2M Hill, Black & Veatch, ICF, PRC, and Ecology and Environment. May.

EPA. 1993. *Final Screening Feasibility Study for Remediation Alternatives at the California Gulch NPL Site, Leadville, Colorado.* September.

EPA. 1995, *Action Memorandum for PRP Financed Removal Action at the Colorado Zinc-Lead Tailings Impoundment Site, Operable Unit 8.* 8HWM-SR. August 4.

EPA. 1996. Selected Mineral Assemblages from 1995 AVIRIS Data, California Gulch Superfund Site,

EPA. 1998. *Action Memorandum for PRP Financed Removal Action at Operable Unit 8.* 8HWM-SR.

EPA. 1999. *A Guide to Preparing Superfund Proposed Plan, Records of Decision, and Other Remedy Selection Decision Documents.* EPA/540/R-98/031. July.

EPA. 2000. *Proposed Plan for Operable Unit 8, California Gulch Superfund Site, Leadville, Colorado.* July 27.

Water & Associates. 1992. Soil Inventory and Map, California Gulch Study Area, Leadville, Colorado. California Gulch Hydrologic Investigation, Leadville, Colorado. August.

Water, Waste, and Land, Inc. (WWL). 1990. *California Gulch Hydrologic Investigation, Leadville, Colorado.* August.

Weston, Roy F., Inc. (Weston). 1991. *Preliminary Human Health Baseline Risk Assessment for the California Gulch NPL Site, Leadville, Colorado.* Prepared by Roy. F. Weston, Inc. for the EPA. December, 1991.

Weston. 1995a. *Baseline Human Health Risk Assessment for the California Gulch Superfund Site, Part C Evaluation of Worker Scenario and Evaluation of Recreational Scenarios.* Prepared by Roy. F. Weston, Inc. for the EPA. April.

Weston. 1995b. *Final Baseline Aquatic Ecological Risk Assessment (BARA), California Gulch, NPL Site.* Prepared by Roy. F. Weston, Inc. for the EPA. September.

Weston. 1996a. *Baseline Human Health Risk Assessment for the California Gulch Superfund Site, Risk to Residents from Lead (Part A).* Prepared by Roy. F. Weston, Inc. for the EPA. January 2.

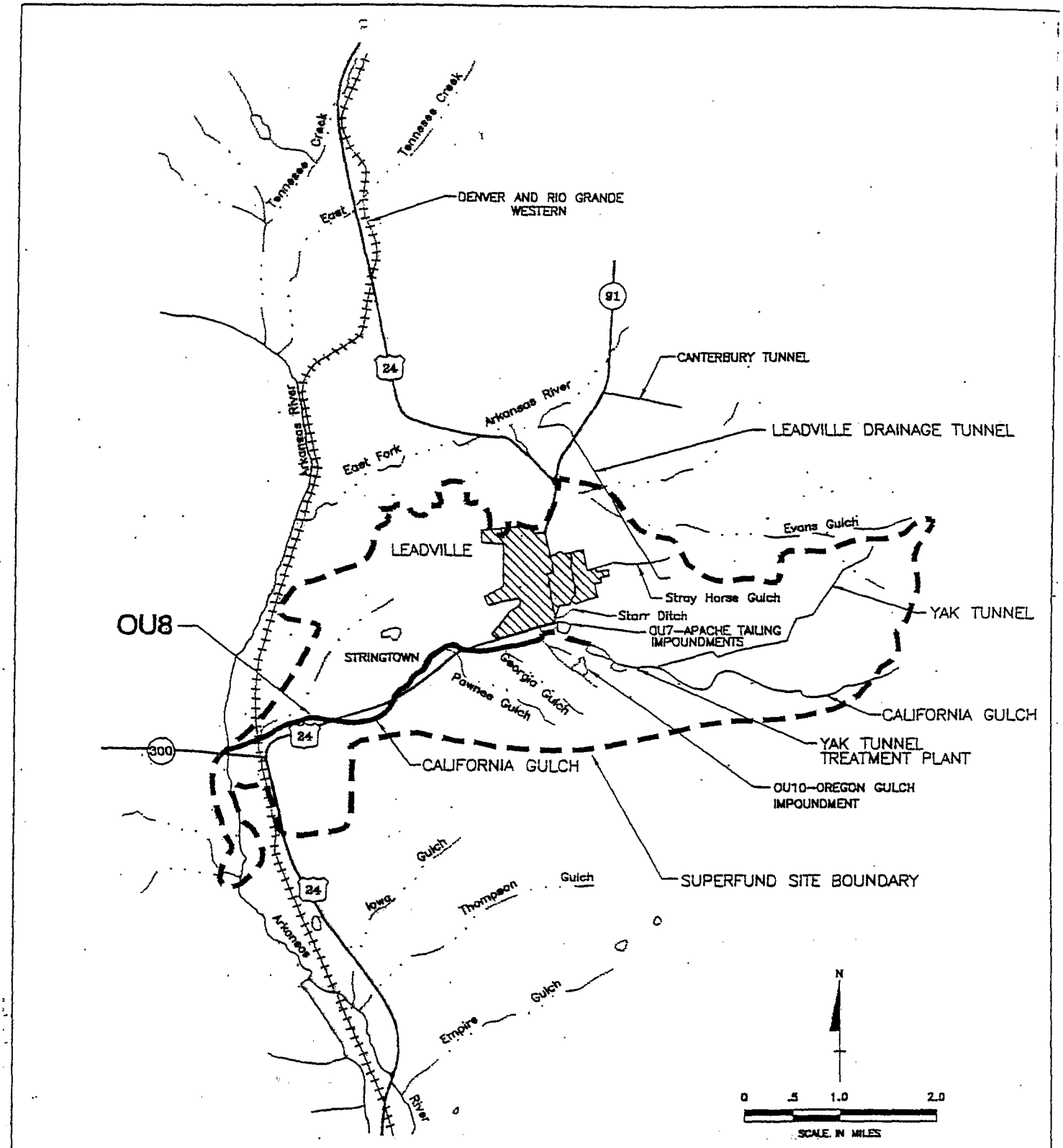
Weston. 1996b. *Baseline Human Health Risk Assessment for the California Gulch Superfund Site, Risk to Residents from Contaminants Other Than Lead (Part B).* Prepared by Roy. F. Weston Inc. for the EPA. January 2.

Weston and Terri Technologies. 1997. *Ecological Risk Assessment for the Terrestrial Ecosystem. California Gulch NPL Site. Leadville, Colorado.* January.

Woodward-Clyde Consultants (WCC). 1992. *Final - Air Quality Monitoring Report, California Gulch Site, Leadville, Colorado.*

WCC. 1994. *Final Tailings Disposal Area Remedial Investigation Report, California Gulch Site, Leadville, Colorado.* January.

FIGURES



LEGEND

CITY OF LEADVILLE

SUPERFUND SITE BOUNDARY

OPERABLE UNIT 8

Figure 1.

SITE LOCATION MAP

California Gulch Superfund Site
Leadville, Colorado

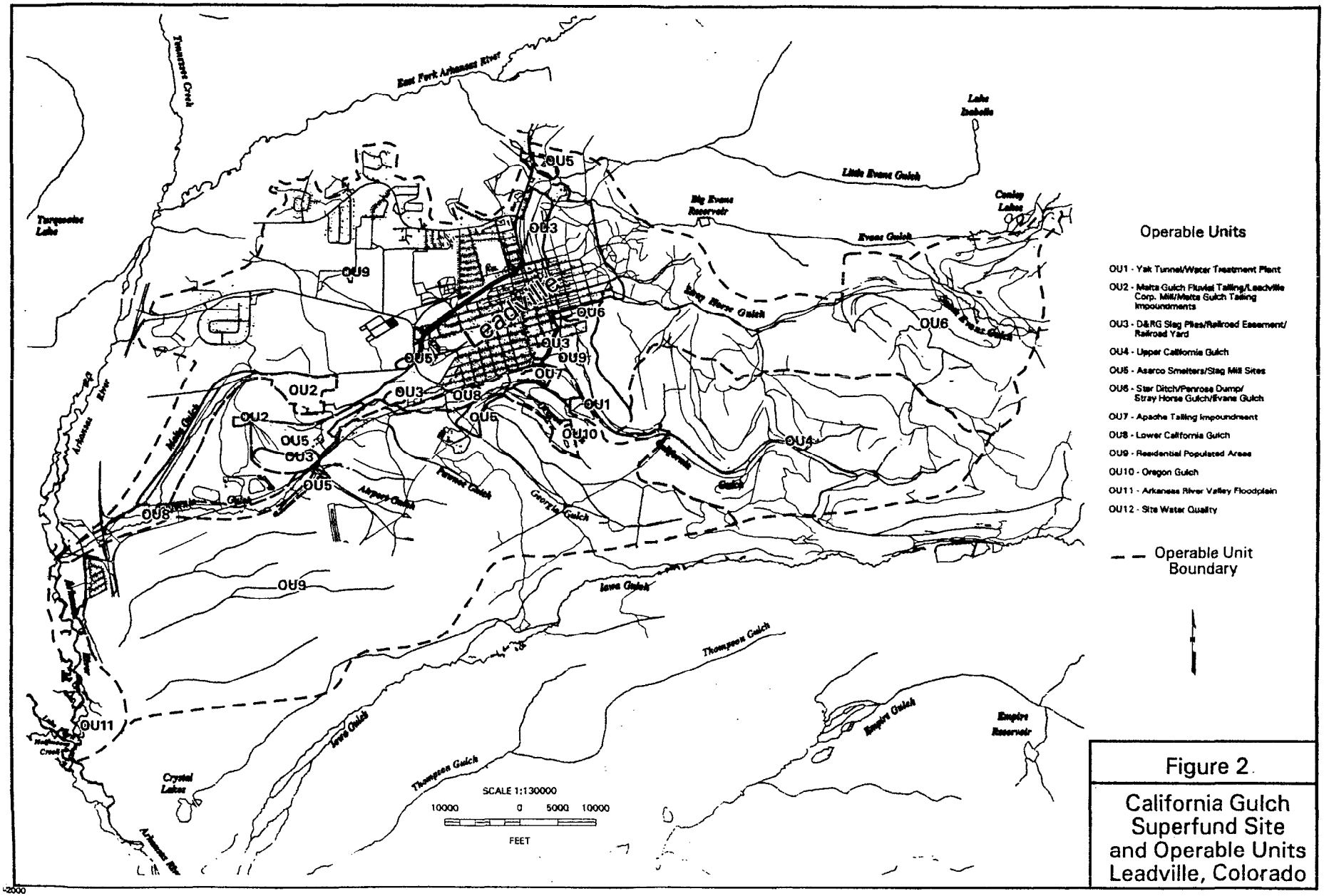


Figure 2

California Gulch Superfund Site and Operable Units Leadville, Colorado

P:\3280-013\OU8\ROD\Fig3.dwg 08\15\00

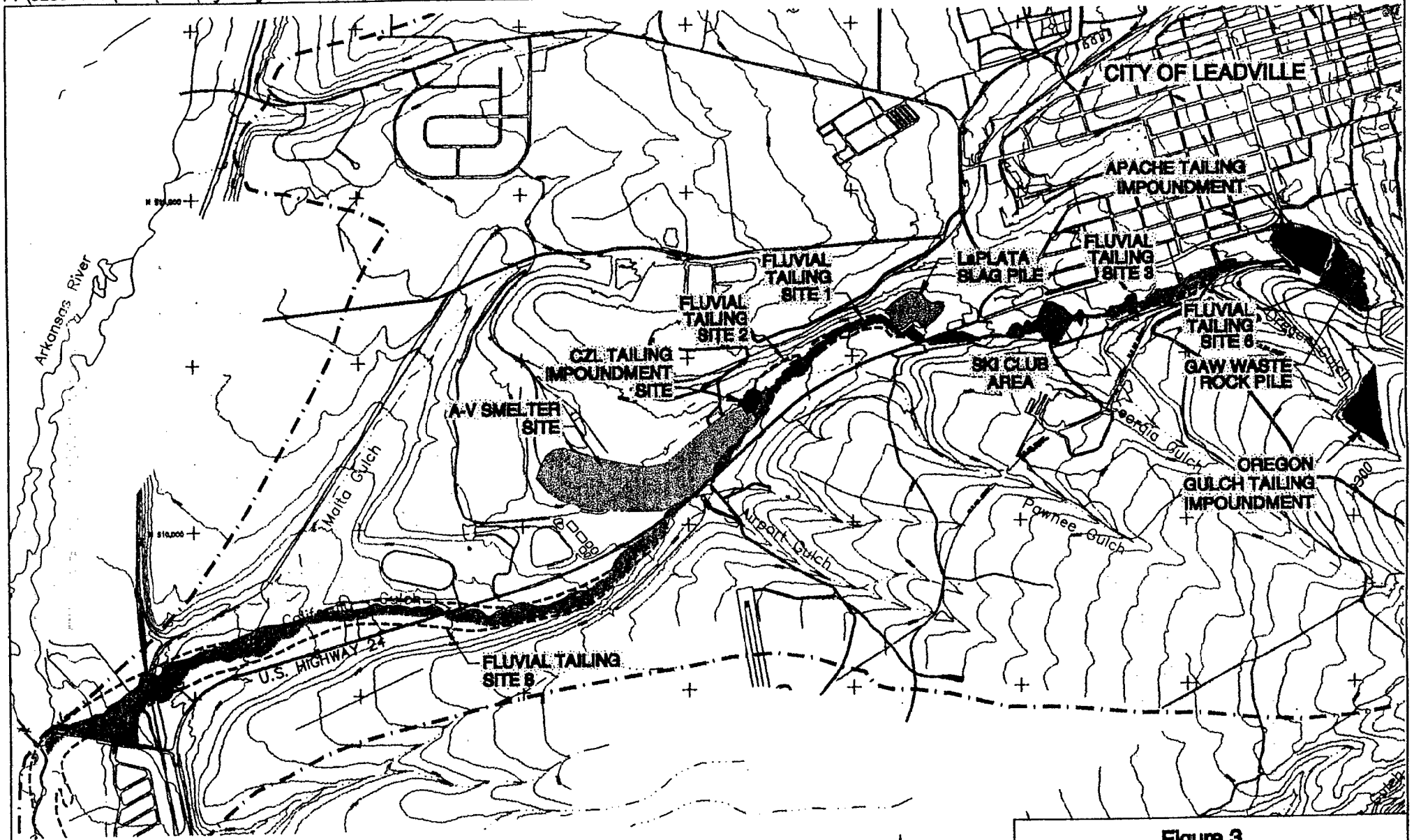


Figure 3

OPERABLE UNIT 8

California Gulch Superfund Site
Leadville, Colorado

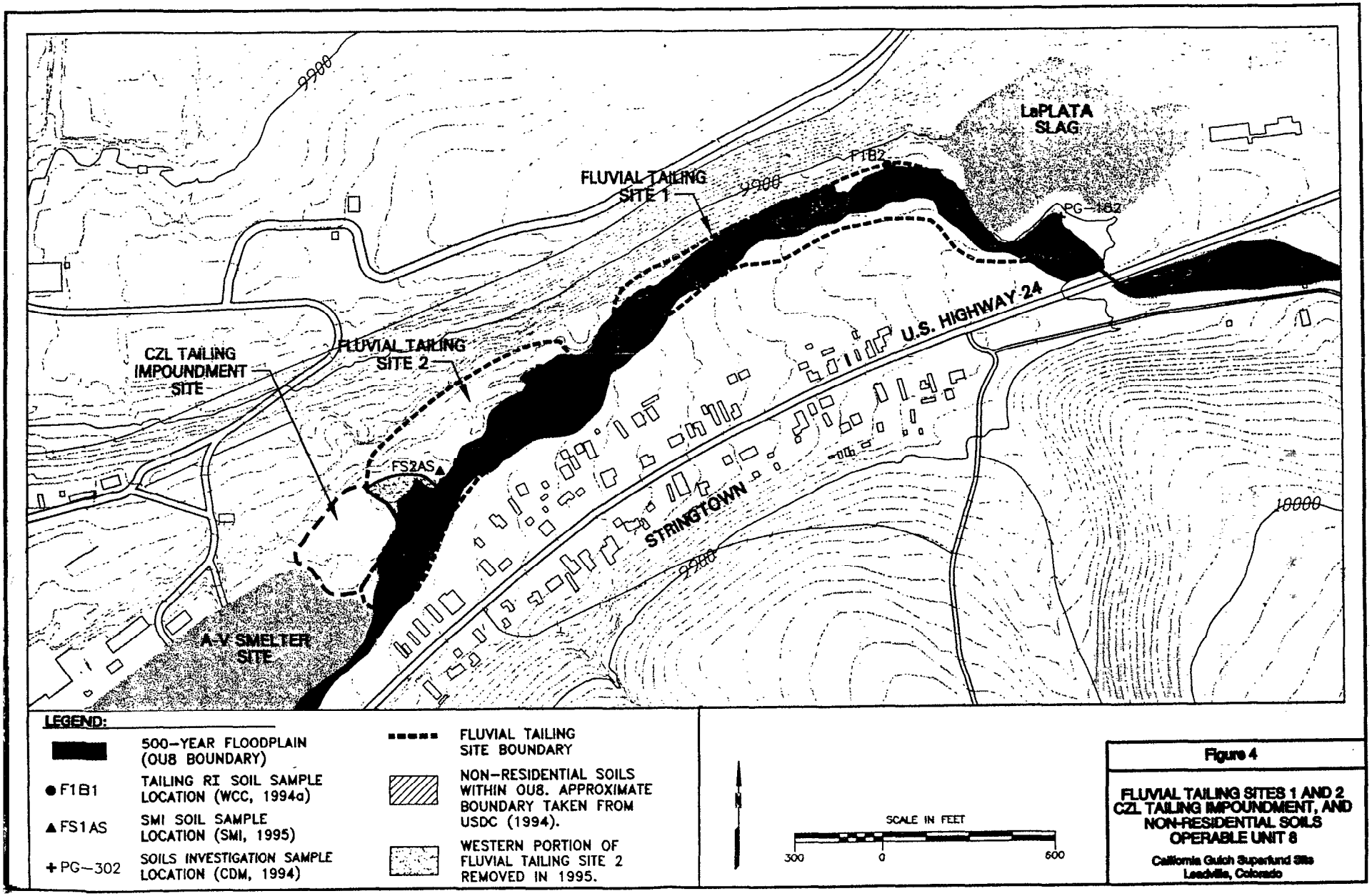


Figure 4

FLUVIAL TAILING SITES 1 AND 2 CZL TAILING IMPOUNDMENT, AND NON-RESIDENTIAL SOILS OPERABLE UNIT 8

California Gulch Superfund Site
Leadville, Colorado

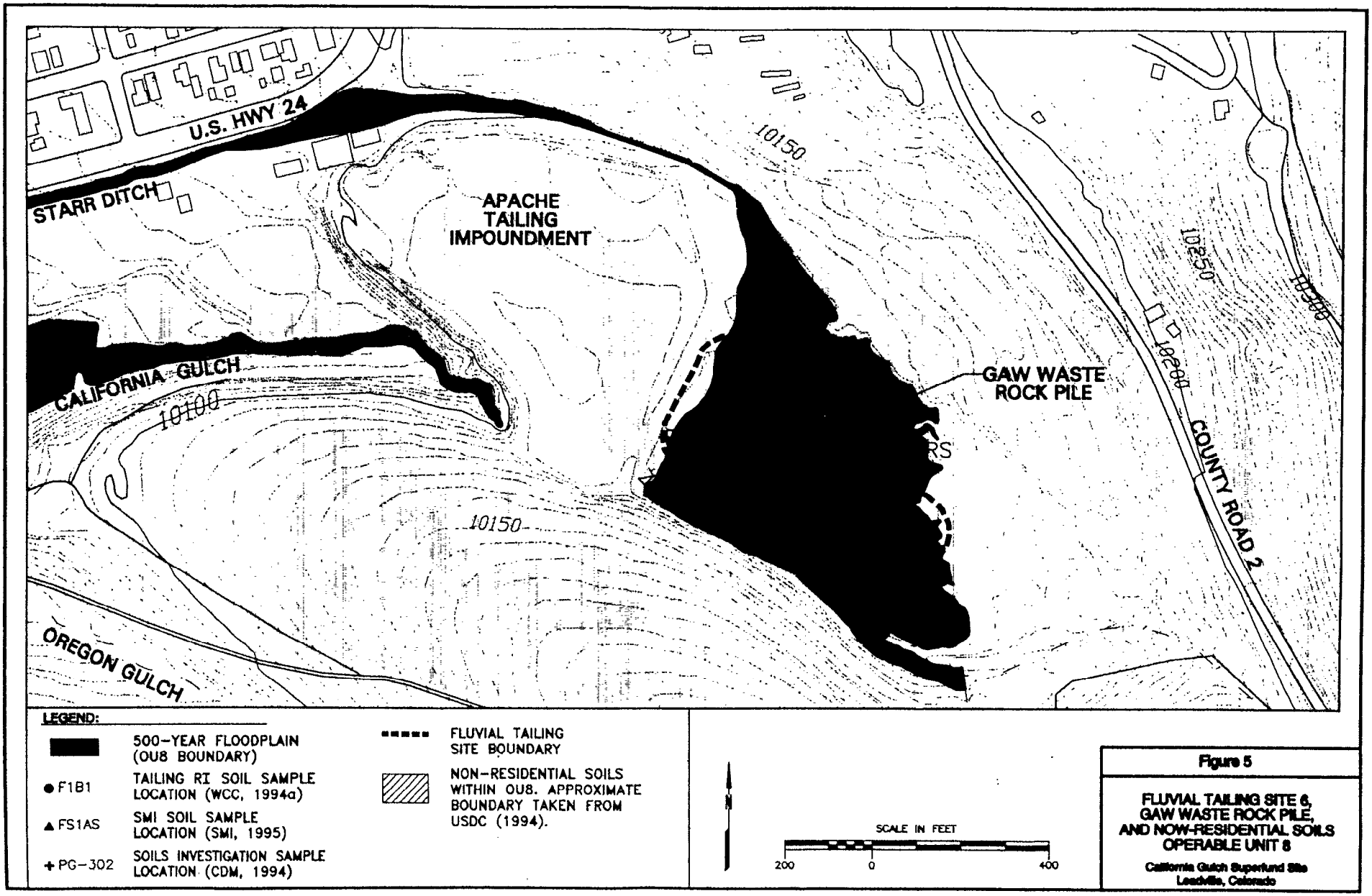


Figure 5

FLUVIAL TAILING SITE 6, GAW WASTE ROCK PILE, AND NOW-RESIDENTIAL SOILS OPERABLE UNIT 8

California Gulch Superfund Site
Leadville, Colorado

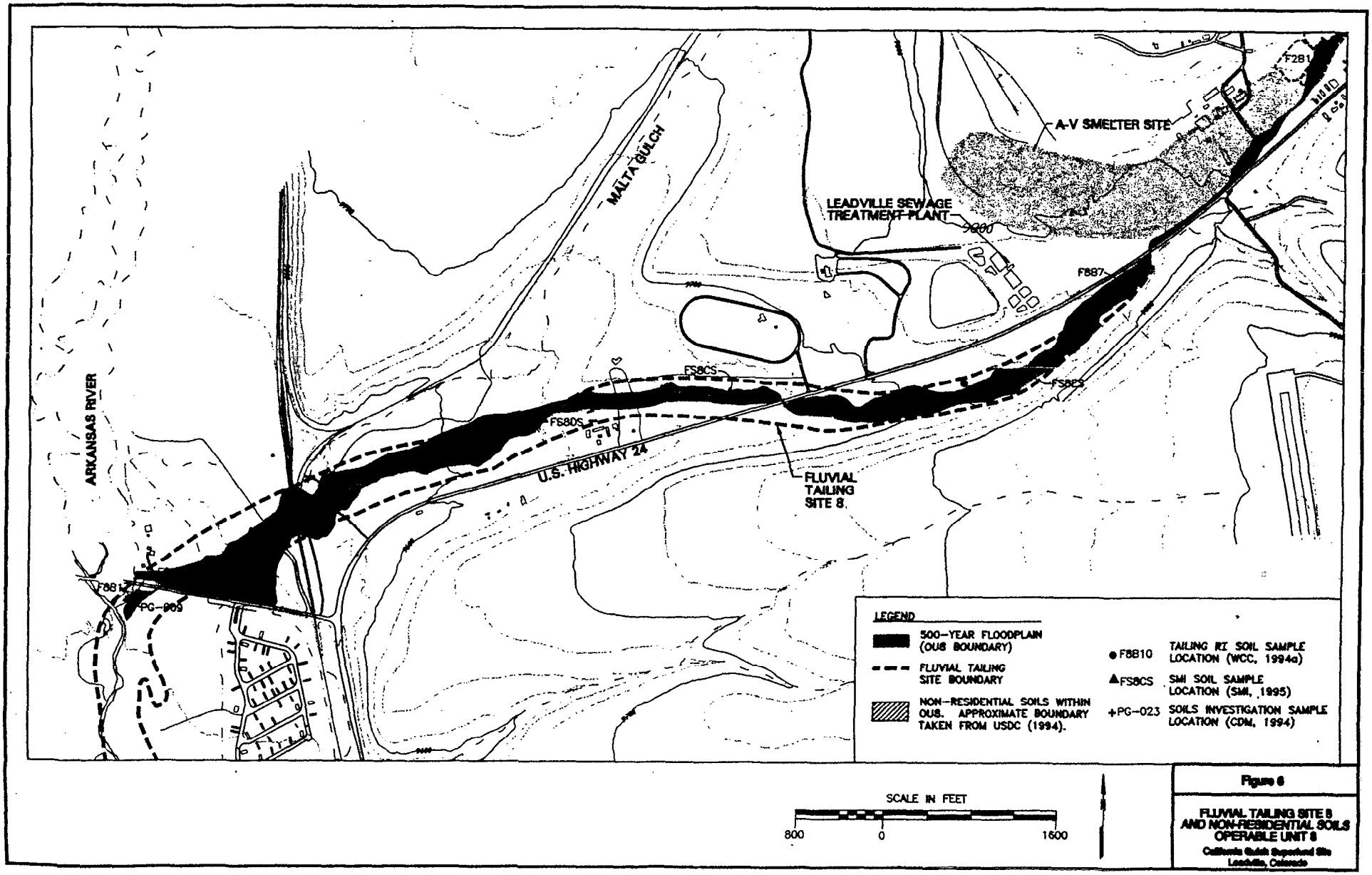
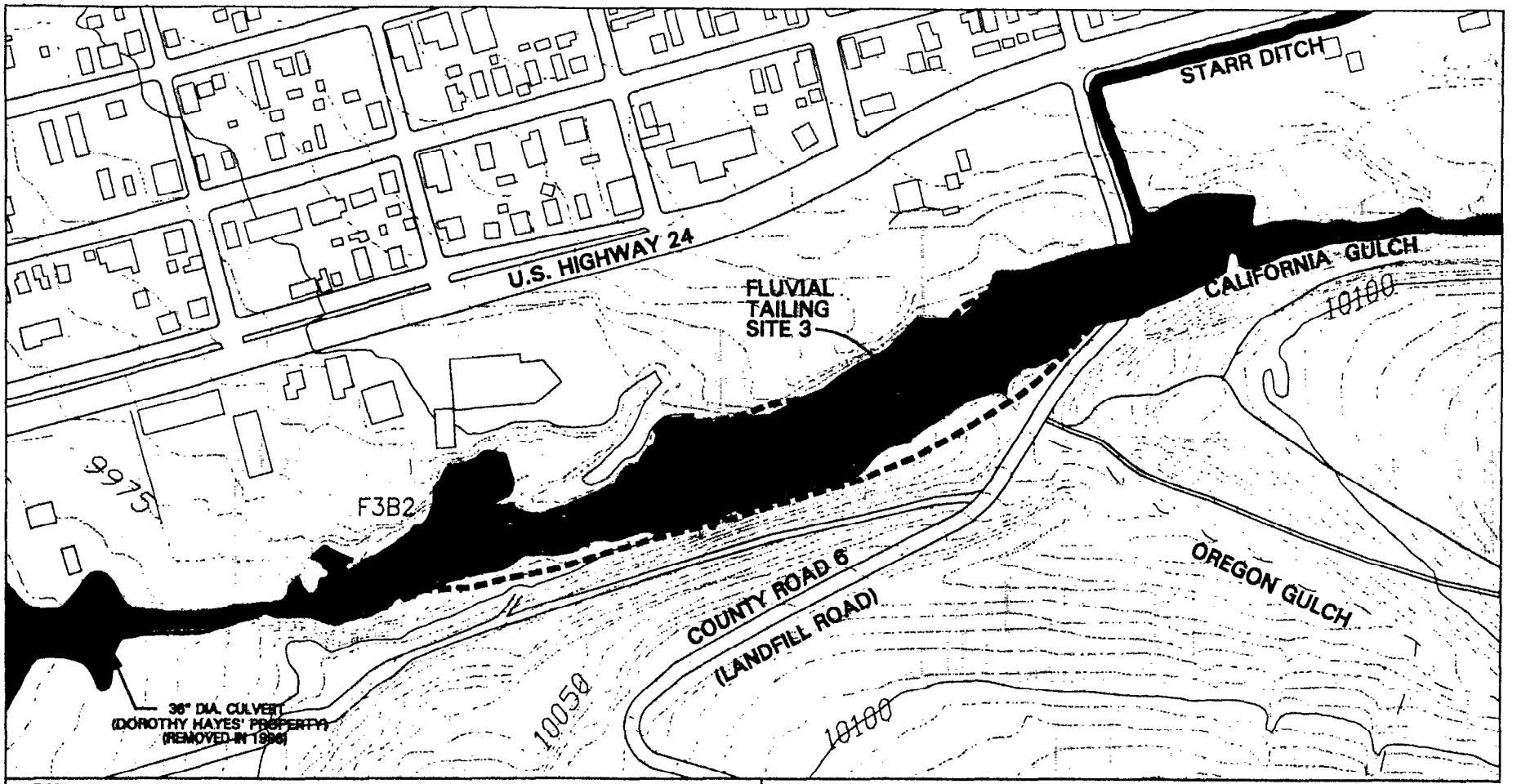


Figure 6

FLUVIAL TAILING SITE 8 AND NON-RESIDENTIAL SOILS OPERABLE UNIT 8

California Gulch Superfund Site
Leadville, Colorado



LEGEND:

- 500-YEAR FLOODPLAIN (OU8 BOUNDARY)
- ● F1B1 — TAILING RI SOIL SAMPLE LOCATION (WCC, 1994a)
- ▲ FS1AS — SMI SOIL SAMPLE LOCATION (SMI, 1995)
- + PG-302 — SOILS INVESTIGATION SAMPLE LOCATION (CDM, 1994)
- FLUVIAL TAILING SITE BOUNDARY
- NON-RESIDENTIAL SOILS WITHIN OU8. APPROXIMATE BOUNDARY TAKEN FROM USDC (1994).

SCALE IN FEET

200 0 400

Figure 7

FLUVIAL TAILING SITE 3 OPERABLE UNIT 8

California Gulch Superfund Site
Leadville, Colorado

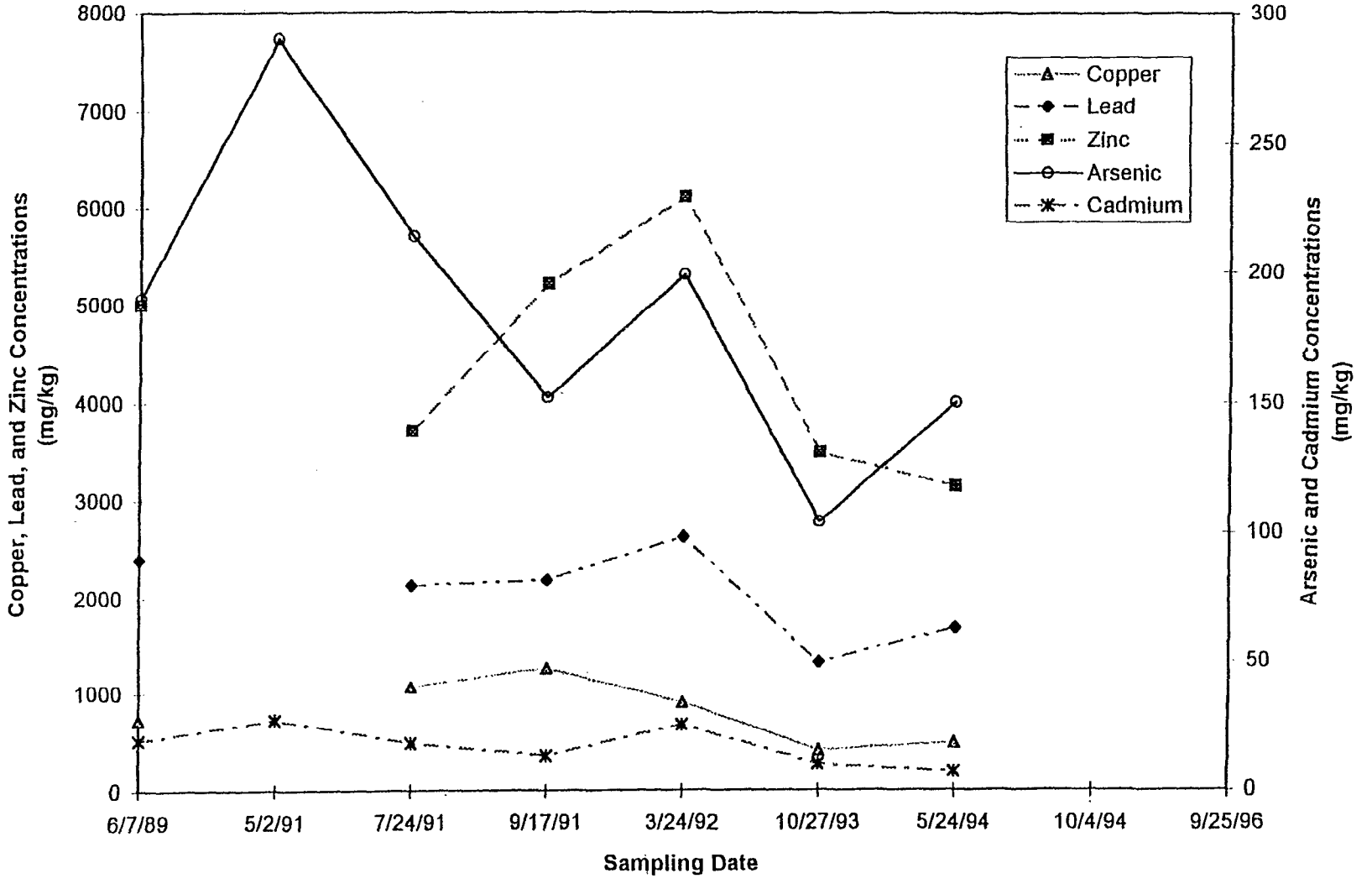


Figure 8

CG 3 SEDIMENT METALS CONTAMINATION

California Gulch Superfund Site, Leadville, Colorado

SOURCE Ecological Risk Assessment for Terrestrial Ecosystem (WESTON, 1997)

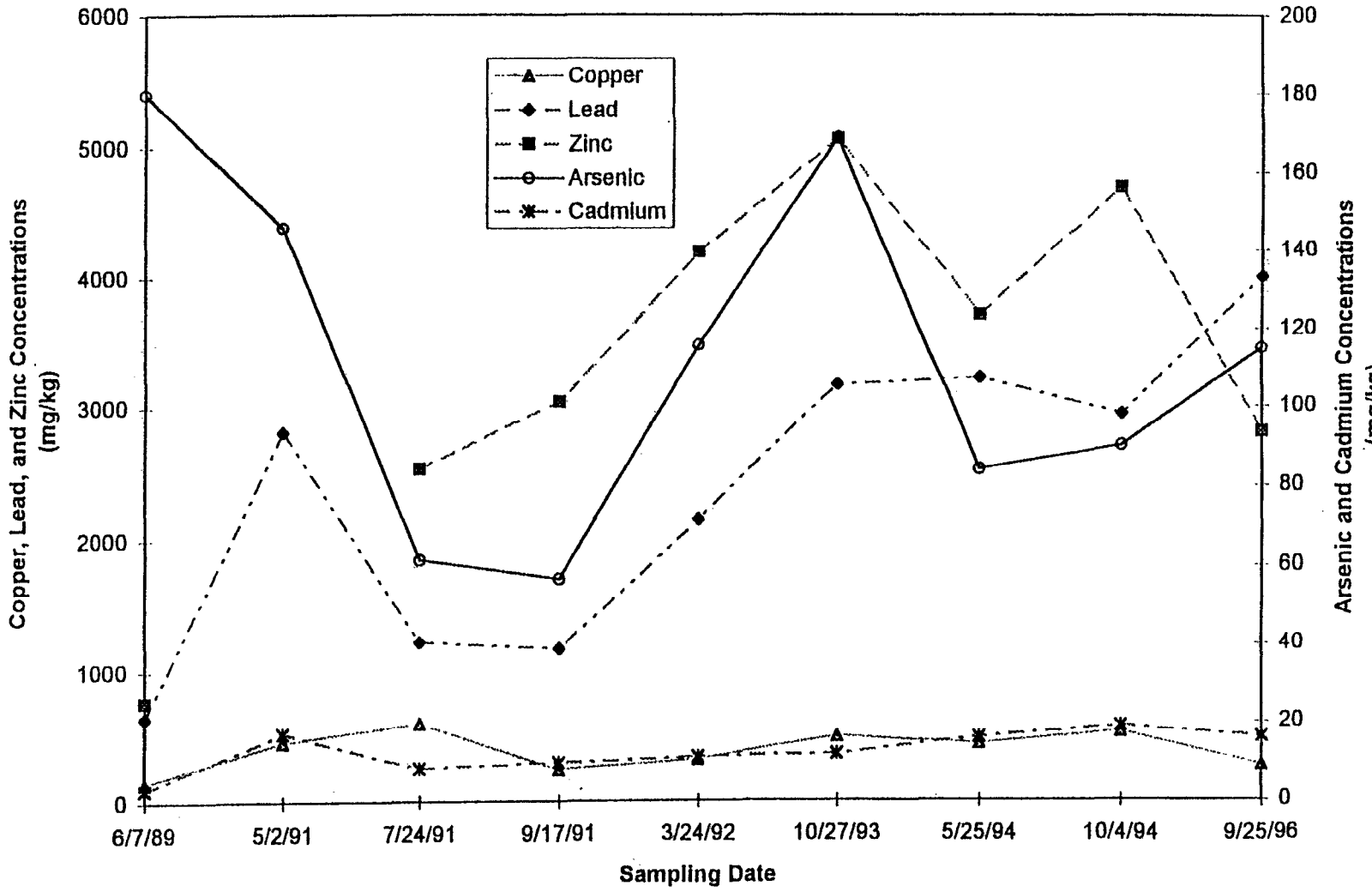


Figure 9

CG 4 SEDIMENT METALS CONTAMINATION

California Gulch Superfund Site, Leadville, Colorado

SOURCE Ecological Risk Assessment for Terrestrial Ecosystem (WESTON, 1997)

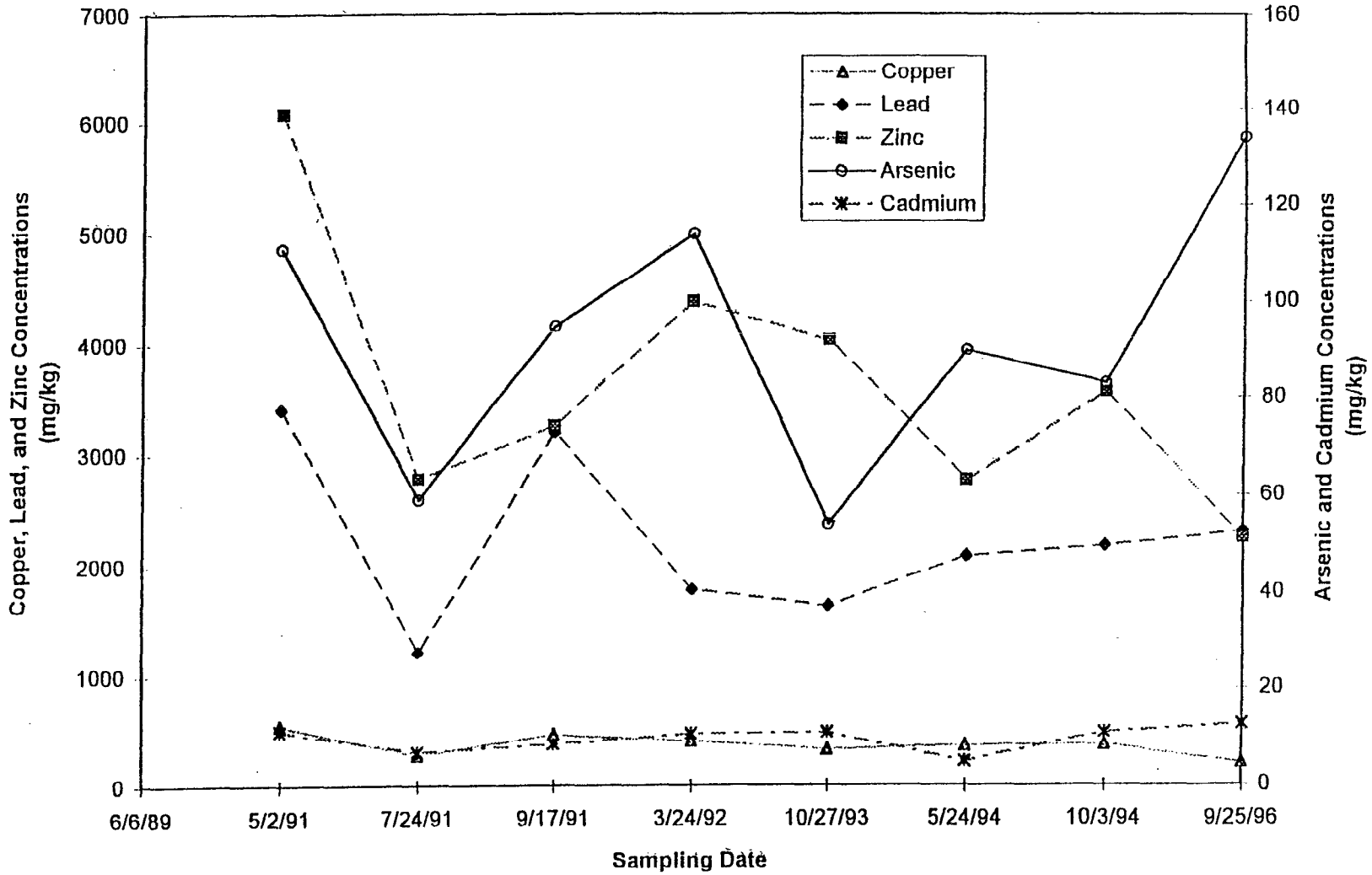


Figure 10

CG 5 SEDIMENT METALS CONTAMINATION

California Gulch Superfund Site, Leadville, Colorado

SOURCE: *Ecological Risk Assessment for Terrestrial Ecosystem* (WESTON, 1997)

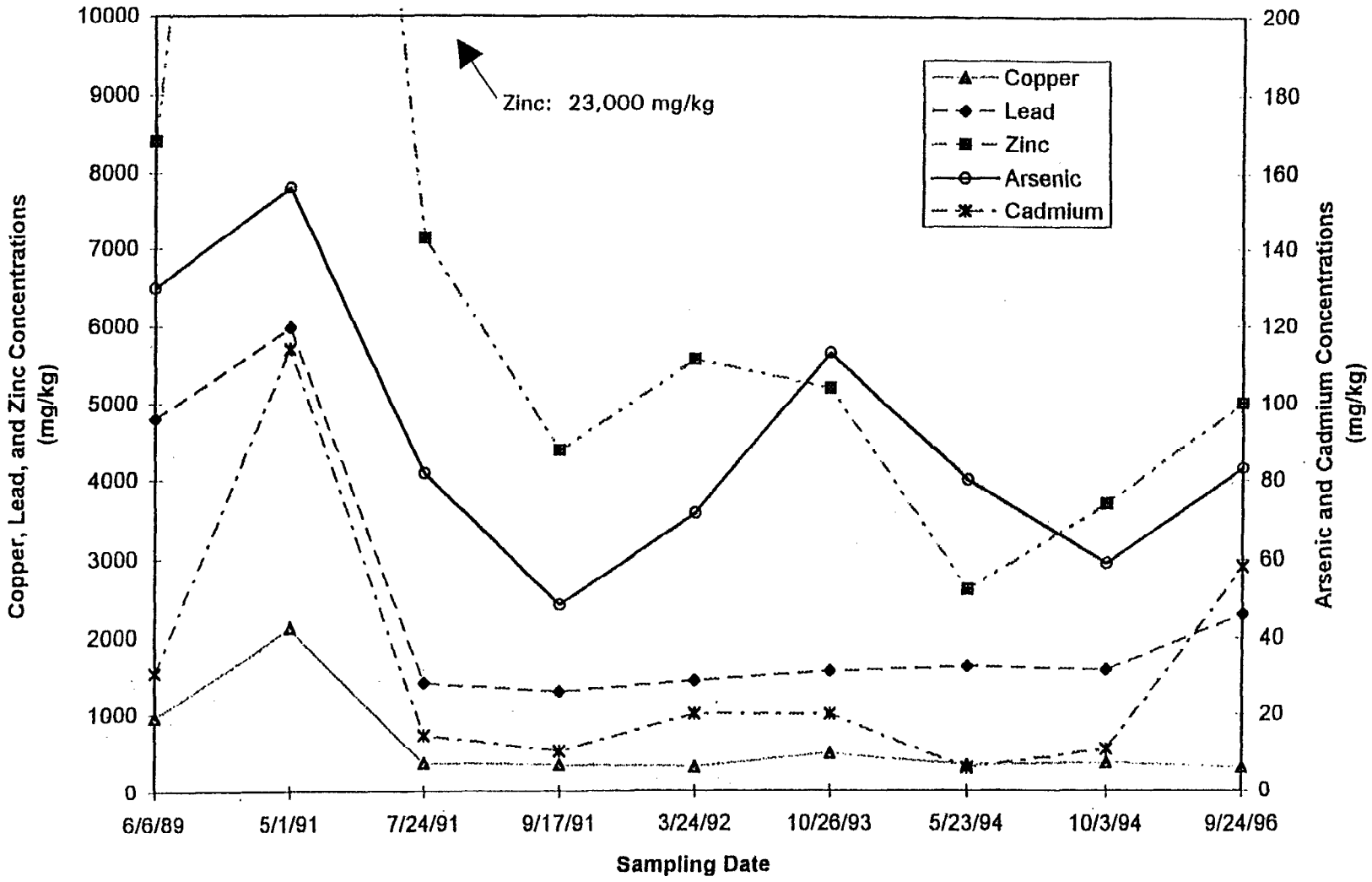
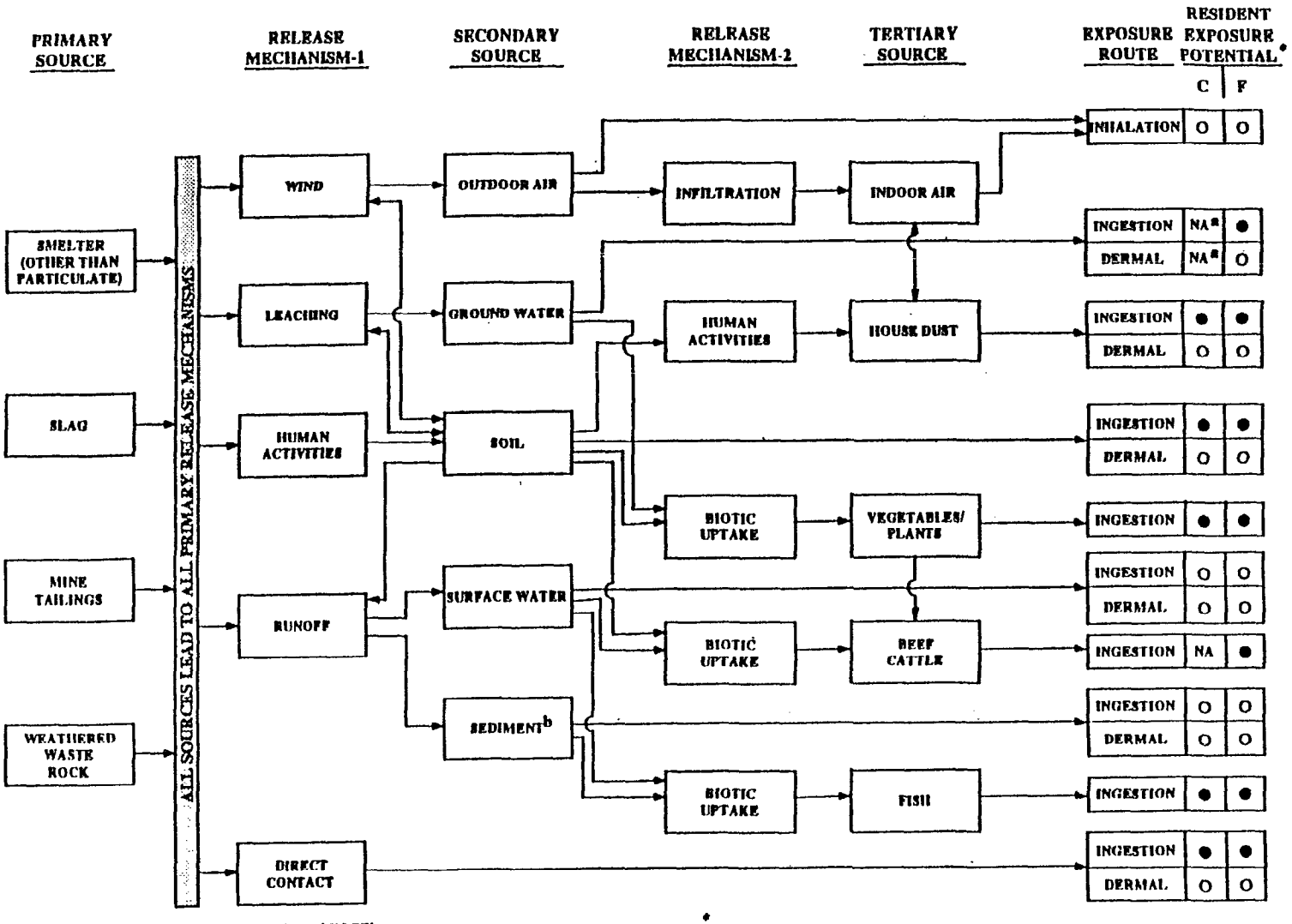


Figure 11

CG 6 SEDIMENT METALS CONTAMINATION

California Gulch Superfund Site, Leadville, Colorado

SOURCE Ecological Risk Assessment for Terrestrial Ecosystem (WESTON, 1997)



O EXPOSURE OR DOSE POTENTIAL RELATIVELY LOW

● EXPOSURE OR DOSE POTENTIAL RELATIVELY HIGH

NA NOT APPLICABLE SINCE EXPOSURE PATHWAY IS NOT COMPLETE

a CURRENTLY INVESTIGATIONS ARE UNDERWAY TO DETERMINE ANY PRESENT GROUNDWATER USAGE IN THE LEADVILLE AREA

b REFERS TO WET SEDIMENTS. DRY SEDIMENTS WOULD BE SIMILAR TO THE PATHWAYS SHOWN FOR SOIL.

* C=CURRENT USE
F=FUTURE USE

SOURCE Preliminary Human Health Baseline Risk Assessment (WESTON, 1991)

Figure 12

HUMAN HEALTH SITE CONCEPTUAL MODEL - LEADVILLE AND STRINGTOWN RESIDENTS, MINING AND ORE PROCESSING WASTES

California Gulch Superfund Site, Leadville, Colorado

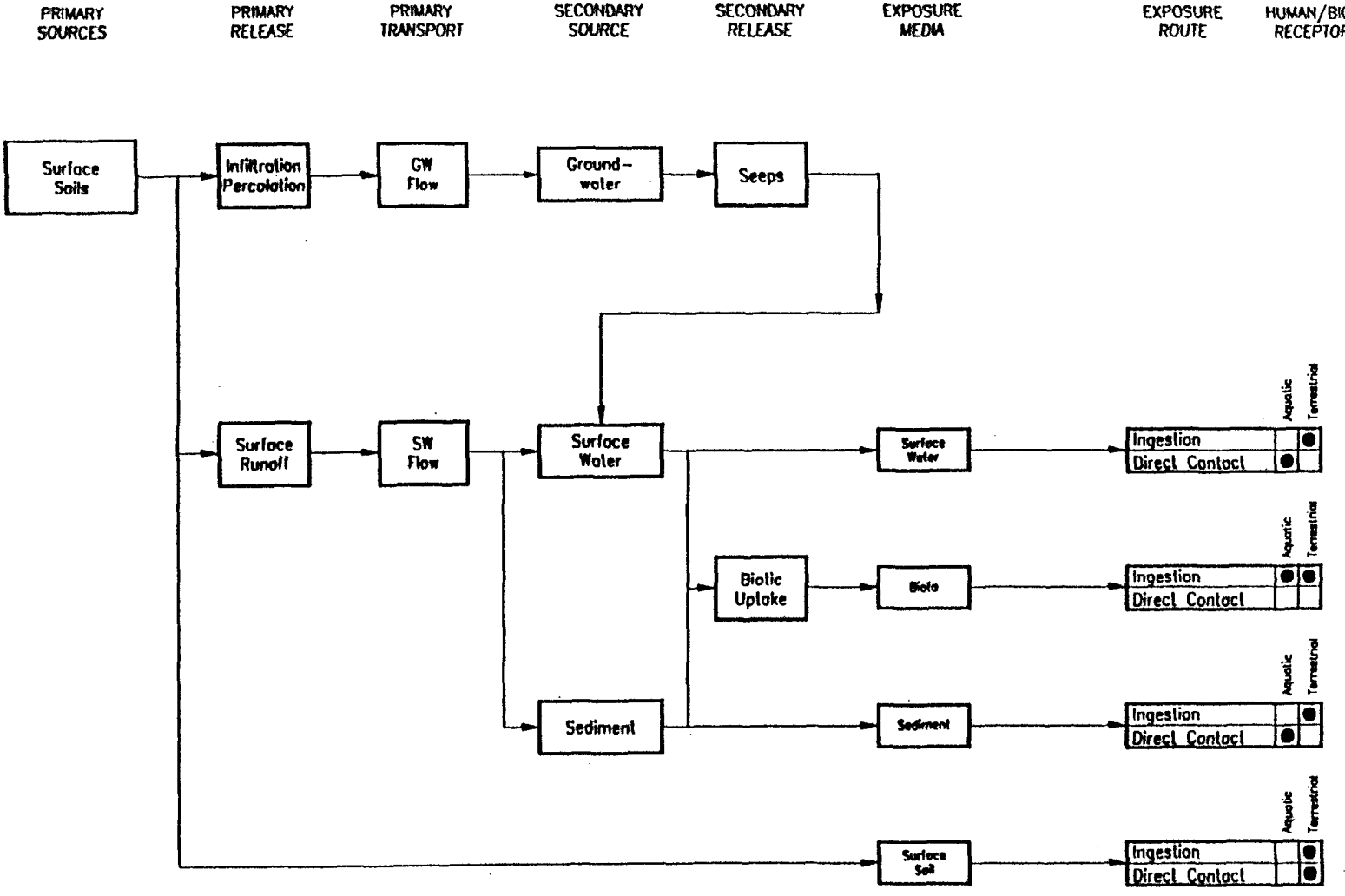
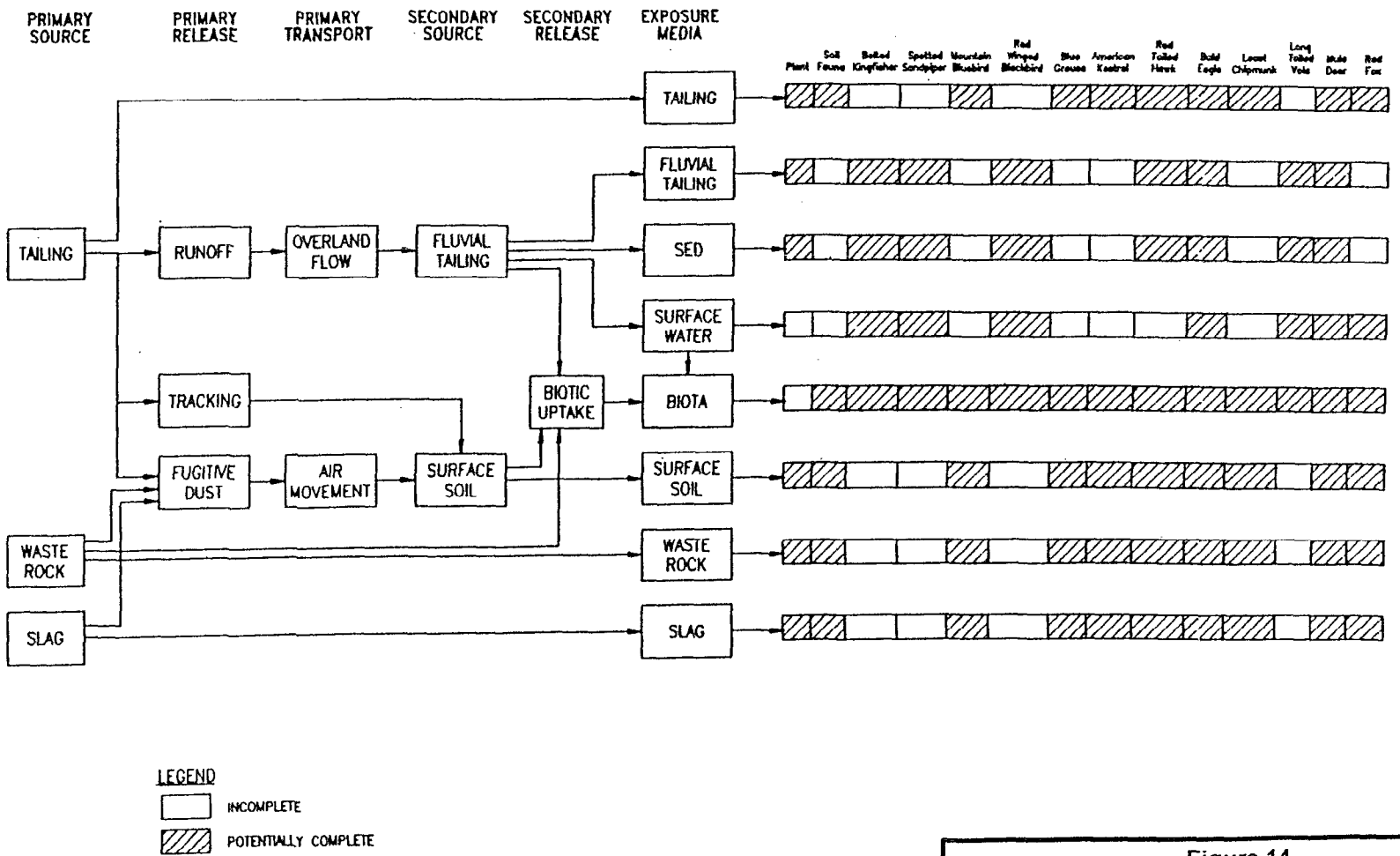


Figure 13

CONCEPTUAL MODEL FOR CALIFORNIA GULCH ECOLOGICAL ASSESSMENT

California Gulch Superfund Site
Leadville, Colorado

SOURCE Final Baseline Aquatic Ecological Risk Assessment (WESTON, 1995b)



SOURCE Ecological Risk Assessment for Terrestrial Ecosystem (WESTON, 1997)

Figure 14

CONCEPTUAL SITE MODEL
ECOLOGICAL RISK ASSESSMENT FOR THE TERRESTRIAL ECOSYSTEM

California Gulch Superfund Site, Leadville, Colorado

TABLES

TABLE 1
SUMMARY OF NON-RESIDENTIAL SOIL SAMPLE XRF METALS ANALYSES(1)
OPERABLE UNIT 8
CALIFORNIA GULCH SUPERFUND SITE

Sample Location and Depth	Arsenic (mg/kg)	Cadmium (mg/kg)	Copper (mg/kg)	Lead (mg/kg)	Zinc (mg/kg)
PG-182 (Adjacent to upstream end of Fluvial Tailing Site 1)					
0" - 1"	0.00*	70.31	597.46	9,838.67	9,678.73
1" - 2"	0.00*	67.30	598.27	10,832.53	9,462.73
2" - 6"	0.00*	53.33	791.29	11,005.46	14,079.82
6" - 12"	0.00*	59.54	742.73	9,654.83	13,144.45
PG-373 (Adjacent to Fluvial Tailing Site 6)					
0" - 1"	0.00*	41.34	198.70	4,718.15	7,053.32
1" - 2"	0.00*	35.30	240.43	7,307.73	9,341.90
2" - 6"	0.00*	33.68	267.89	8,437.84	7,281.43
6" - 12"	0.00*	28.11	272.54	10,708.31	5,289.67
12" - 18"	0.00*	37.44	310.68	8,007.75	6,300.92

Notes: (1) Source: CDM. 1994

* = Minimum values of 0.00 for cadmium and arsenic represent "no XRF response"
mg/kg = milligrams/kilogram
XRF = X-ray fluorescence

TABLE 2
SUMMARY OF FLUVIAL TAILING SITE SOIL SAMPLE METALS ANALYSES
OPERABLE UNIT 8
CALIFORNIA GULCH SUPERFUND SITE

Sample Location and Depth	Arsenic (mg/kg)	Cadmium (mg/kg)	Copper (mg/kg)	Lead (mg/kg)	Zinc (mg/kg)
XRF Analysis - PG-302 (Fluvial Tailing Site 3) [(1)]					
0" - 1"	0.00*	12.60	400.44	2,884.17	4,376.05
1" - 2"	0.00*	29.73	549.51	2,939.95	5,129.14
2" - 6"	0.00*	11.28	564.38	3,577.61	3,430.13
6" - 12"	82.49	9.41	701.66	5,797.03	3,447.05
12" - 18"	0.00*	0.00*	823.39	5,729.79	4,003.01
XRF Analysis - PG-374 (Fluvial Tailing Site 6) [(1)]					
0" - 1"	188.18	13.82	474.05	7,813.71	3,487.18
1" - 2"	180.35	0.00*	376.92	6,606.64	2,928.67
2" - 6"	0.00*	-2	244.72	4,265.14	4,483.63
6" - 12"	0.00*	36.8	70.95	1,223.58	3,171.36
12" - 18"	0.00*	-2	49.49	1,280.96	2,114.45
XRF Analysis - PG-009 (Fluvial Tailing Site 8) [(1)]					
0" - 1"	166.72	18.03	468.85	3,384.89	5,118.56
1" - 2"	0.00*	30.58	583.23	4,104.01	5,125.20
2" - 6"	0.00*	39.86	676.12	4,596.72	6,243.49
6" - 12"	59.58	9.19	528.77	3,948.05	4,593.18
XRF Analysis - PG-023 (Fluvial Tailing Site 8) [(1)]					
0" - 1"	0.00*	21.09	370.16	3,878.26	2,258.54
1" - 2"	0.00*	36.27	194.44	724.89	5,257.01
2" - 6"	0.00*	8.29	207.32	399.21	4,029.17
6" - 12"	0.00*	5.66	103.24	147.24	1,092.95
12" - 18"	0.00*	0.00*	120.75	620.62	1,227.42

TABLE 2 (continued)
SUMMARY OF FLUVIAL TAILING SITE SOIL SAMPLE METALS ANALYSES
OPERABLE UNIT 8
CALIFORNIA GULCH SUPERFUND SITE

Sample Location and Depth	Arsenic (mg/kg)	Cadmium (mg/kg)	Copper (mg/kg)	Lead (mg/kg)	Zinc (mg/kg)
XRF Analysis - EG-025 (Fluvial Tailing Site 8) (1)					
0" - 1"	0.00*	23.49	242.75	2,159.59	2,915.50
1" - 2"	0.00*	28.07	225.62	2,396.00	3,570.88
2" - 6"	0.00*	6.30	72.86	352.31	672.45
6" - 12"	0.00*	2.94	46.45	181.06	279.54
12" - 18"	0.00*	4.67	47.81	249.21	396.55
Summary of SPLP (EPA Method 1312) Result - Maximum Values (mg/L) (2)					
FTS1	ND	0.53	NA	7.00	21.6
FTS2	0.34	0.56	NA	2.22	74.4
FTS3	ND	0.02	NA	9.18	2.09
FTS6	ND	1.9	NA	2.34	147
FTS8	ND	1.39	NA	2.24	145
Total Metal Concentrations Analysis Results - Surface Tailing Samples (mg/kg) (2)					
FTS1	214	12.7	250	5,780	2,290
FTS2	R	19.5	NA	R	R
FTS3	172	17.4	437	3,220	4,170
FTS6	108	45.9	263	3,250	6,710
FTS8	193	55	344	7,750	6,320
Range of Total Metal Concentrations - Sub-surface Tailing Samples (mg/kg) (2)					
FTS1	ND-257	1.3-15.9	NA	67.7-5330	537-560
FTS2	107-267	13.8-17.3	1,580	9,410-10,400	2,220-8,640
FTS3	267	1.5-3	NA	12,400	1,050
FTS6	180-562	3.11-111	NA	3,070-11,200	1,110-23,700
FTS8	ND-213	0.87-67.7	12.2-845	64.3-18,100	826-27,200

Notes:

(1) Camp Dresser & McKee, Inc. 1994. *Soils Investigation Data Report, California Gulch CERCLA Site, Leadville, Colorado.* July.

(2) Woodward Clyde Consultants. 1994. *Tailings Disposal Area Remedial Investigation Report, California Gulch Site, Leadville, Colorado.* January.

S = Analyte was not detected at the concentration listed
* = Minimum values of 0.00 for cadmium and copper represent "no XRF response"
mg/kg = milligrams/kilogram
NA = Analyte was not analyzed for
ND = Analyte not detected
R = Data rejected
SPLP = Synthetic Precipitation Leach Procedure
XRF = X-ray fluorescence

TABLE 3
OU8 AREAS AND FLUVIAL TAILING VOLUME
OPERABLE UNIT 8
CALIFORNIA GULCH SUPERFUND SITE

Site	Total Area (acres)	Wetlands Area (acres)	Average Tailing Thickness (ft)	Estimated Tailing Volume (cy)
FTS1	3.4	2.8	1*	5,500
FTS2	3.2	2.3	1*	5,200
FTS3	4.8	3.2	5*	38,800
FTS6	4.2	1.4	0.5**	3,400
FTS8	45	11.4	0.25*	18,200
OU8 (including CZL Tailing Impoundment Site)	97	29	-----	71,100

Note: Acreage estimates based on boundary of OU8 defined as the California Gulch 500-year floodplain (Simons and Associates, 1997). Wetland areas based on delineation of waters of the U.S. and wetlands (Cooper and D'Amico, 1997).

*Estimate from Tailing Remedial Investigation (WCC, 1994a).

**Estimate from (SMI/TerraMatrix, 1995a)

TABLE 4
UPGRADIENT TO DOWNGRADIENT GROUND WATER COMPARISON
FLUVIA TAILING SITE 1
OPERABLE UNIT 8
CALIFORNIA GULCH SUPERFUND SITE

Upgradient Well: NW15
Downgradient Well: CZ1TMW1

Sample Location	NW15	NW15	NW15	NW15			
Date	**11/14/89**	**10/21/93**	**6/3/94**	**10/10/94**			
Arsenic, diss	0.005	0.001	0.001	0.001			
Cadmium, diss	0.035	0.0228	0.017	0.023			
Copper, diss	0.01	0.01	0.01	0.01			
Lead, diss	0.005	0.001	0.001	0.001			
Sulfate	NM	459	432	438			
TDS, Filterable	810	772	770	786			
Zinc, diss	17	12	13.7	14.8			
Field pH	NM	6.62	6.48	6.43			
Field Conductivity	NM	1,140	1,050	1,039			

Sample Location	**CZ1TMW1**	**CZ1TMW1**	**CZ1TMW1**	**CZ1TMW1**	**CZ1TMW1**	**CZ1TMW1**	
Date	**11/19/91**	**10/22/93**	**6/1/94**	**10/6/94**	**1/26/95**	**5/31/95**	
Arsenic, diss	0.01	0.001	0.002	0.001	0.001	0.001	
Cadmium, diss	0.151	0.112	0.09	0.0033	0.12	0.09	
Copper, diss	0.025	0.01	0.01	0.01	0.01	0.001	
Lead, diss	0.0036	0.003	0.003	0.002	0.002	0.001	
Sulfate	735	660	527	611	517	570	
TDS, Filterable	1,070	1,024	869	964	795	860	
Zinc, diss	57.5	47.9	39.5	44.8	37.4	42.5	
Field pH	6.7	6.35	6.23	6.31	6.18	6.22	
Field Conductivity	1,238	1,227	1,009	1,124	971	1,020	

TABLE 4 (continued)
UPGRADIENT TO DOWNGRADIENT GROUND WATER COMPARISON
FLUVIAL TAILING SITE 1
OPERABLE UNIT 8
CALIFORNIA GULCH SUPERFUND SITE

Upgradient Well: NW15
Downgradient Well: CZ1TMW1

Sample Location / Date		Number of Samples	NW15 Average	NW15 Max	NW15 Min
Arsenic, diss		4	0.002	0.01	0.001
Cadmium, diss		4	0.024	0.04	0.017
Copper, diss		4	0.010	0.01	0.01
Lead, diss		4	0.002	0.01	0.001
Sulfate		3	443	459	432
TDS, Filterable		4	785	810	770
Zinc, diss		4	14	17	12
Field pH		3	6.48	6.62	6.43
Field Conductivity		3	1,076	1,140	1,039

Sample Location / Date	CZ1TMW1 9/27/95	CZ1TMW1 6/4/96	CZ1TMW1 9/24/96	Number of Samples	CZ1TMW1 Average	CZ1TMW1 Max	CZ1TMW1 Min
Arsenic, diss	0.001	0.001	0.001	9	0.002	0.01	0.001
Cadmium, diss	0.17	0.13	0.19	9	0.12	0.19	0.003
Copper, diss	0.002	0.001	0.001	9	0.008	0.03	0.001
Lead, diss	0.001	0.003	0.002	9	0.002	0.00	0.001
Sulfate	762	670	680	9	637	762	517
TDS, Filterable	1,170	1,190	1,080	9	1,002	1,190	795
Zinc, diss	55.1	48.9	46.8	9	46.7	57.5	37.4
Field pH	6.06	5.71	6.13	9	6.22	6.70	5.71
Field Conductivity	1,397	1,214	1,216	9	1,157	1,397	971

Note:
All concentrations in mg/L except conductivity (umhos/cm) and pH (std. units)
Averages include non-detects at the detection limit
Median pH reported instead of average, NM = Not measured.

TABLE 5
SUMMARY OF COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES
OPERABLE UNIT 8
CALIFORNIA GULCH SUPERFUND SITE

Evaluation Criteria	Impounded Tailing	Non-Residential Area Soils	
	No Further Action	No Action	Containment
	Alternative 1	Alternative 1	Alternative 2
OVERALL PROTECTIVENESS			
Human Health Protection			
S Airborne transport of particles	The tailing have been removed. Existing conditions meet the RAOs and are protective of human health and environment.	Does not meet RAOs.	Good overall protection Reduces airborne transport.
S Erosion of materials into surface water	The tailing have been removed. Existing conditions meet the RAOs and are protective of human health and environment.	Does not meet RAOs.	Good overall protection. Meets RAOs Would reduce potential for erosion. Reduces the potential for risk to the aquatic ecosystem.
S Metals leaching into surface water	The tailing have been removed. Existing conditions meet the RAOs and are protective of human health and environment.	Does not meet RAOs.	Good overall protection. Meets RAOs. Would reduce potential for erosion. Reduces the potential for risk to the aquatic ecosystem.
S Metals leaching into ground water	The tailing have been removed. Existing conditions meet the RAOs and are protective of human health and environment.	Does not meet RAOs. However, metals loading could not be attributed to leaching of metals from non-residential area soils.	Good overall protection. Meets RAOs. Would reduce potential for leaching of metals from soils to surface water in remediated areas. Reduces the potential for risk to the aquatic ecosystem.
Environmental Protection	The tailing have been removed. Existing conditions meet the RAOs and are protective of human health and environment.	Does not meet RAOs. However, metals loading to surface water or groundwater could not be attributed to leaching of metals from non-residential area soils	Good overall protection. Meets RAOs. Reduces the potential for risk to the terrestrial and aquatic ecosystems.
COMPLIANCE WITH ARARs			
Chemical-specific	Complies with ARARs.	Not an issue, no remediation activities would take place.	Complies with ARARs.
Location-specific	Complies with ARARs.	Not an issue, no remediation activities would take place.	Complies with ARARs.
Action-specific	Complies with ARARs.	Not an issue, no remediation activities would take place.	Complies with ARARs.
Other criterion or guidance	Complies with ARARs.	Not an issue, no remediation activities would take place.	Complies with ARARs.
LONG-TERM EFFECTIVENESS			
Magnitude of Residual Risk			
S Airborne transport of particles	Excellent long-term effectiveness and permanence. Tailing have been removed	No change from existing conditions	A greater level of long-term effectiveness and permanence.
S Erosion of material into surface water	Excellent long-term effectiveness and permanence. Tailing have been removed.	No change from existing conditions	A greater level of long-term effectiveness and permanence.
S Metals leaching into surface water	Excellent long-term effectiveness and permanence. Tailing have been removed	No change from existing conditions	A greater level of long-term effectiveness and permanence

TABLE 5 (continued)
SUMMARY OF COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES
OPERABLE UNIT 8
CALIFORNIA GULCH SUPERFUND SITE

Evaluation Criteria	Impounded Tailing	Non-Residential Area Soils	
	No Further Action	No Action	Containment
	Alternative 1	Alternative 1	Alternative
S Metals leaching into groundwater	Excellent long-term effectiveness and permanence. Tailing have been removed.	No change from existing conditions.	A greater level of long-term effectiveness and permanence.
Adequacy and Reliability of Controls	Excellent long-term effectiveness and permanence. Tailing have been removed.	No change from existing conditions.	A greater level of long-term effectiveness and permanence.
REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT			
Reduction of Toxicity, Mobility or Volume	Treatment not applicable. Tailing have been previously removed.	Does not include treatment.	Does not include treatment.
SHORT-TERM EFFECTIVENESS			
Community Protection	Excellent short-term effectiveness.	No change in existing conditions. No disturbance, since no remediation activities would take place.	Minimal disturbance during implementation. Slight potential for short-term risk due to dust emissions However, fugitive dust emissions would be controlled by standard construction practices.
Worker Protection	Excellent short-term effectiveness.	No charge in existing conditions. No disturbance, since no remediation activities would take place.	Minimal disturbance during implementation Slight potential for short-term risk due to dust emissions. However, fugitive dust emissions would be controlled by standard construction practices.
Environmental Impacts	Excellent short-term effectiveness	No change in existing conditions. No disturbance, since no remediation activities would take place.	Minimal disturbance during implementation. Slight potential for short-term risk due to dust emissions. However, fugitive dust emissions would be controlled by standard construction practices.
Time Until Action is Complete	Not applicable.	Not applicable.	One to two years.
IMPLEMENTABILITY			
Ability to Construct and Operate	No construction or operation.	No construction or operation.	Good, requires land owner consent to implement alternative on private property.
Ease of Doing More Action if Needed	Easily implemented.	Easily implemented.	Good.
Ability to Monitor Effectiveness	No monitoring.	No monitoring.	Good.
Ability to Obtain Approvals and Coordinate with Other Agencies	No approval necessary.	No approval necessary.	Good, requires land owner consent to implement alternative on private property.
Availability of Equipment, Specialist, in Materials	None required.	None required.	Good.
Availability of Technologies	None required.	None required.	Good.

TABLE 5 (continued)
SUMMARY OF COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES
OPERABLE UNIT 8
CALIFORNIA GULCH SUPERFUND SITE

Evaluation Criteria	Impounded Tailing	Non-Residential Area Soils	
	No Further Action	No Action	Containment
	Alternative 1	Alternative 1	Alternative 2
COSTS			
Capital Cost	$0	$0	$48,600
Annual O&M Cost	$0	$0	$4,800
Present Worth Cost (5% rate or return, 30 year period)	$0	$0	$107,000
STATE ACCEPTANCE			
State Acceptance	Alternative preferred by the State	Alternative not preferred by the State	Alternative preferred by the State
COMMUNITY ACCEPTANCE			
Community Acceptance	Alternative preferred by the community	Alternative not preferred by the community	Alternative preferred by the community

TABLE 6
SUMMARY OF COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES
OU8 - OPERABLE UNIT 8
CALIFORNIA GULCH SUPERFUND SITE

Evaluation Criteria	Waste Rock	Fluvial Tailing		Stream Sediment		
	No Action	No Action	Containment	No Action	Sediment Removal and Channel Reconstruction in FTS3 and FTS6	Complete Sediment Removal and Charnel Reconstruction
	Alternative 1	Alternative 1	Alternative 2	Alternative 1	Alternative 2	Alternative 3
OVERALL PROTECTIVENESS						
Human Health Protection						
— Airborne transport of particles	The Gaw waste rock pile was not identified as a source of risk to human health or the environment. Existing conditions at the Gaw pile achieve the RAOs defined for waste rock.	Does not meet RAOs. No change in existing conditions.	Good overall protection. Meets RAOs. Would reduce potential for erosion and leaching of metals. Reduces existing potential for risk to the terrestrial ecosystem	Not applicable. Not an RAO for stream sediment.	Not applicable. Not an RAO for stream sediment	Not applicable. Not an RAO for Stream sediment.
— Erosion of materials into surface water	The Gaw waste rock pile was not identified as a source of risk to human health or the environment. Existing conditions at the Gaw pile achieve the RAOs defined for waste rock	Does not meet RAOs. No change in existing conditions.	Good overall Protection. Meets RAOs. Would reduce potential for erosion and leaching of metals Reduces existing potential for risk to the terrestrial ecosystem.	No change in existing conditions.	Meets RAOs. Erosion of existing sediment would be controlled.	Meets RAOs. Erosion from existing sediment would be eliminated
— Metals leaching into surface water	The Gaw waste rock pile was not identified as a source of risk to human health or the environment Existing conditions at the Gaw pile achieve the RAOs defined for waste rock	Does not meet RAOs. No change in existing conditions.	Good overall protection. Meets RAOs. Would reduce potential for erosion and leaching of metals. Reduces existing potential for risk to the terrestrial ecosystem.	No change in existing conditions.	Meets RAOs. Potential for leaching of metals from existing sediment would be reduced.	Meets RAOs. Potential for leaching of metals from existing sediment would be eliminated.
— Metals leaching into ground water	The Gaw waste rock pile was not identified as a source of risk to human health or the environment Existing conditions at the Gaw pile achieve the RAOs defined for waste rock.	Does not meet RAOs. No change in existing conditions.	Good overall protection. Meets RAOs. Would reduce potential for erosion and leaching of metals. Reduces existing potential for risk to the terrestrial ecosystem.	No change in existing conditions.	Meets RAOs. Potential for leaching of metals from existing sediment would be reduced.	Meets RAOs. Potential for leaching of metals from existing sediment would be eliminated.
Environmental Protection	The Gaw waste rock pile was not identified as a source of risk to human health or the environment Existing conditions at the Gaw pile achieve the RAO& defined for waste rock	Does not meet RAOs No change in existing conditions.	Good overall protection. Meets RAOs. Would reduce potential for erosion and leaching of metals. Reduces existing potential fix risk to the terrestrial ecosystem.	No charge in existing conditions.	Meets RAOs. Reduces existing risk to riparian ecosystem.	Meets RAOs Reduces existing risk to riparian ecosystem

TABLE 6 (continued)
SUMMARY OF COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES
OU8 - OPERABLE UNIT 8
CALIFORNIA GULCH SUPERFUND SITE

Evaluation Criteria	Waste Rock	Fluvial Tailing		Stream Sediment		
	No Action	No Action	Containment	No Action	Sediment Removal and Channel Reconstruction in FTS3 and FTS6	Complete Sediment Removal and Channel Reconstruction
	Alternative 1	Alternative 1	Alternative 2	Alternative 1	Alternative 2	Alternative 3
COMPLIANCE WITH ARARs						
Chemical-specific	Not in issue, no action would take place.	Not an issue, no activities would take place.	Complies with ARARs.	Not an issue; no activities would take place	Complies with ARARs	Complies with ARARs.
Location-specific	Not in issue, no action would take place.	Not an issue, no activities would take place.	Complies with ARARs.	Not an issue, no activities would take place	Complies with ARARs, short-term disturbance to existing wetlands in specific areas would likely result.	Complies with ARARs, extensive short-term disturbance to existing floodplain and wetland areas would result. Wetland mitigation may be required and net reduction in wetland areas may occur.
Action-specific	Not an issue, on action would take place.	Not an issue, no activities would take place.	Complies with ARARs.	Not an issue, no activities would take place.	Complies with ARARs, short-term disturbance to existing wetlands in specific areas would likely result	Complies with ARARs, extensive short-term disturbance to existing floodplain and wetland areas would result. Wetland mitigation may be required and net reduction in wetland areas may occur.
Other criterion or guidance	Not an issue, no action would take place	Not an issue, no activities would take place.	Complies with ARARs.	Not an issue; no activities would take place.	Complies with ARARs.	Complies with ARARs.
LONG-TERM EFFECTIVENESS						
Magnitude or Residual Risk						
- Airborne transport of	No change in long-term effectiveness and permanence.	No change in existing conditions.	A much greater level of long-term effectiveness and permanence.	No change in existing conditions.	A higher level of long-terms effectiveness. Introduction of sediment from upstream areas into OU8 would not be prevented.	A much greater level long-term effectiveness. Introduction of sediment from upstream areas into OU8 would not be prevented.
-Erosion of material into surface water	No change in long-term effectiveness and permanence.	No change in existing conditions.	A much greater level of long-term effectiveness and permanence.	No change in existing conditions.	A higher level of long-terms effectiveness. Introduction of sediment from upstream areas into OU8 would not be prevented.	A much greater level long-term effectiveness. Introduction of sediment from upstream areas into OU8 would not be prevented.

TABLE 6 (continued)
SUMMARY OF COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES
OU8 - OPERABLE UNIT 8
CALIFORNIA GULCH SUPERFUND SITE

Evaluation Criteria	Waste Rock	Fluvial Tailing		Stream Sediment		
	No Action	No Action	Containment	No Action	Sediment Removal and Channel Reconstruction in FIS3 and FTS6	Complete Sediment Removal and Charnel Reconstruction
	Alternative 1	Alternative 1	Alternative 2	Alternative 1	Alternative 2	Alternative 3
— Metals leaching into surface water	No change in long-term effectiveness and permanence.	No change in existing conditions.	A much greater level long-term effectiveness and permanence.	No change in existing conditions.	A higher level of long-terms effectiveness. Introduction of sediment from upstream areas into OU8 would not be prevented.	A much greater level long-terms effectiveness. Introduction of sediment from upstream areas into OU8 would not be prevented.
— Metals leaching into groundwater	No change in long-term effectiveness and permanence.	No change in existing conditions.	A much greater level long-term effectiveness and permanence.	No change in existing conditions.	A higher level of long-terms effectiveness. Introduction of sediment from upstream areas into OU8 would not be prevented.	A much greater level long-terms effectiveness. Introduction of sediment from upstream areas into OU8 would not be prevented.
Adequacy and Reliability of Controls	No change in long-term effectiveness and permanence.	No change in existing conditions.	A much greater level long-term effectiveness and permanence.	No change in existing conditions.	A higher level of long-terms effectiveness. Introduction of sediment from upstream areas into OU8 would not be prevented.	A much greater level long-terms effectiveness. Introduction of sediment from upstream areas into OU8 would not be prevented.
REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT						
Reduction of Toxicity, Mobility or Volume	Does not include treatment.	Does not include treatment.	Does not include treatment.	Does not include treatment.	Does not include treatment	Does not include treatment.
SHORT-TERM EFFECTIVENESS						
Community Protection	No disturbance to the community or to the environment would occur, since no action would take place.	No disturbance to the community or environment since no activities would take place.	Minimal disturbance and some short-term risk during construction due to increased traffic and potential for dust generation during remediation activities.	No disturbance to the community or environment, since no activities would take place.	Minimal-term risk due to increased traffic, dust emissions, and release of sediment during remediation activities. Short-term disturbance to existing wetlands in specific areas.	Short-term risk due to increased traffic, dust emissions, and release of sediment during remediation activities. Extensive short-term disturbance to existing wetland and floodplain areas and to riparian habitat.
Worker Protection	No disturbance to the community or to the environment would occur, since no action would take place.	No disturbance to the community or environment since no activities would take place.	Minimal disturbance and some short-term risk during construction due to increased traffic and potential for dust generation during remediation activities.	No disturbance to the community or environment, since no activities would take place.	Minimal-term risk due to increased traffic, dust emissions, and release of sediment during remediation activities. Short-term disturbance to existing wetlands in specific areas.	Short-term risk due to increased traffic, dust emissions, and release of sediment during remediation activities. Extensive short-term disturbance to existing wetland and floodplain areas and to riparian habitat.

TABLE 6 (continued)
SUMMARY OF COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES
OU8 - OPERABLE UNIT 8
CALIFORNIA GULCH SUPERFUND SITE

Evaluation Criteria	Waste Rock	Fluvial Tailing		Stream Sediment		
	No Action	No Action	Containment	No Action	Sediment Removal and Channel Reconstruction in FTS3 and FTS6	Complete Sediment Removal and Channel Reconstruction
	Alternative 1	Alternative 1	Alternative 2	Alternative 1	Alternative 2	Alternative 3
Environmental Impacts	No disturbance to the community or to the environment would occur, since no action would take place.	No disturbance to the community or environment since no activities would take place.	Minimal disturbance and some short-term risk during construction due to increased traffic and potential for dust generation during remediation activities.	No disturbance to the community or environment, since no activities would take place.	Minimal short-term risk due to increased traffic, dust emissions, and release of sediment during remediation activities. Short-term disturbance to existing wetlands in specific areas.	Short-term risk due to increased traffic, dust emissions, and release of sediment during remediation activities. Extensive short-term disturbance to existing wetland and floodplain areas and to riparian habitat.
Time Until Action is Complete	Not Applicable	Not Applicable	One Year	Not Applicable	One to two years	Two Years
IMPLEMENTABILITY						
Ability to Construct and Operate	No construction or operation	No construction or operation	Good. Requires land owner consent to implement on private property.	No construction or operation.	Good. Requires land owner consent to implement on private property.	Difficult to implement. Requires land owner consent to implement on private property.
Ease of Doing More Action if Needed	Easily implemented	Easily implemented	Good	Easily implemented	Good	Easy
Ability to Monitor Effectiveness	No monitoring	No monitoring	Good	No monitoring	Good	Easy
Ability to Obtain Approvals and Coordinate with Other Agencies	No approval necessary.	No approval necessary.	Good, requires land owner consent to implement on private property.	No approval necessary.	Good. Requires land owner consent to implement on private property.	Difficult to implement. Requires land owner consent to implement on private property
Availability of Equipment, Specialist, and Materials	None required	None required	Good	None required	Good	Good
Availability of Technologies	None required	None required	Good	None required	Good	Good

TABLE 6 (continued)
SUMMARY OF COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES
OU8 - OPERABLE UNIT 8
CALIFORNIA GULCH SUPERFUND SITE

Evaluation Criteria	Waste Rock	Fluvial Tailing		Stream Sediment		
	No Action	No Action	Containment	No Action	Sediment Removal and Channel Reconstruction in FTS3 and FTS6	Complete Sediment Removal and Channel Reconstruction
	Alternative 1	Alternative 1	Alternative 2	Alternative 1	Alternative 2	Alternative 3
COSTS						
Capital Cost	$0	$0	$987,700	$0	$711,000	$4,880,000
Annual O&M Cost	$0	$0	$38,000	$0	$6,400	$55,200
Present Worth Cost (7% rate of return, 30 year period)	$0	$0	$1,510,000	$0	$792,000	$5,865,000
STATE ACCEPTANCE						
State Acceptance	Alternative not preferred by the State.	Alternative not preferred by the State.	Alternative preferred by the State.	Alternative not preferred by the State.	Alternative preferred by the State.	Alternative not preferred by the State.
COMMUNITY ACCEPTANCE						
Community Acceptance	Alternative not preferred by the community.	Alternative not preferred by the community.	Alternative preferred by the community.	Alternative not preferred by the community.	Alternative preferred by the community.	Alternative not preferred by the community.

TABLE 7
SUMMARY OF FEDERAL AND STATE CHEMICAL-SPECIFIC ARARS
OPERABLE UNIT 8
CALIFORNIA GULCH SUPERFUND SITE

Standard, Requirement, Criteria, or Limitation	Citation	Potentially Applicable	Potentially Relevant and Appropriate	Description
FEDERAL				
Clean Air Act, National Primary and Secondary Ambient Air Quality Standards	40 CFR Part 50	No	No	National ambient air quality standards (NAAQS) are implemented through the New Source Review Program and State Implementation Plans (SIPs). The federal New Source Review program address only major sources. Emissions associated with proposed remedial action in OU8 will be limited to fugitive dust emissions associated with earth moving activities during construction and will occur in isolated areas over a short period of time. These activities will not constitute a major source. Therefore, attainment and maintenance of NAAQS pursuant to the New Source Review Program are not ARARs. See Colorado Air Pollution Prevention and Control Act concerning applicability of requirements implemented through the SIP.
RCRA Land Disposal Restrictions (LDRs)	40 CFR Part 268	No	No	RCRA LDRs are not applicable because the materials in issue have been identified as extraction or beneficiation wastes that are specifically exempted from the definition of a hazardous waste. Not relevant and appropriate, see Superfund LDR Guide #7.

TABLE 7 (continued)
SUMMARY OF FEDERAL AND STATE CHEMICAL-SPECIFIC ARARS
OPERABLE UNIT 8
CALIFORNIA GULCH SUPERFUND SITE

Standard, Requirement, Criteria, or Limitation	Citation	Potentially Applicable	Potentially Relevant and Appropriate	Description
STATE OF COLORADO				
Colorado Air Pollution Prevention and Control Act	5 CCR 1001-14 5 CCR 1001-10 Part C (I) Regulation 8	Yes	---	Pursuant to the Colorado Air Pollution Prevention and Control Act, applicants for construction permits are required to evaluate whether the proposed source will exceed NAAQS. Applicants are also required to evaluate whether the proposed activities would cause an exceedance of the Colorado ambient standard for particulate 10 microns or less in aerodynamic diameter (PM 10). Emissions associated with construction activities proposed remedial action in OU8 will generate only fugitive dust emissions at isolated areas over a short period of time. Colorado regulates fugitive emissions through Regulation No. 1. Compliance with applicable provisions of the Colorado air quality requirements will be achieved by adhering to a fugitive emissions control plan prepared in accordance with Regulation No. 1. This plan will discuss monitoring requirements, if any, necessary to achieve these standards. Regulation 8 sets emission limits for lead. Applicants are required to evaluate whether the proposed activities would result in the Regulation 8 lead standard being exceeded. The proposed remedial action in OU8 is not projected to exceed the emission levels for lead, although some lead emissions may occur. Compliance with Regulation 8 will be achieved by adhering to a fugitive emissions control plan prepared in accordance with Regulation No. 1. This plan will discuss monitoring requirements, if any, necessary to achieve these standards.

TABLE 8
SUMMARY OF FEDERAL AND STATE LOCATION-SPECIFIC ARARS
OPERABLE UNIT 8
CALIFORNIA GULCH SUPERFUND SITE

Standard, Requirement, Criteria, or Limitation	Citation	Potentially Applicable	Potentially Relevant and Appropriate	Description
FEDERAL				
Endangered Species Act	16 USC § 1531 et seq 50 CFR §§ 200 and 402	No	No	Provides protection for threatened and endangered species and their habitats. However, site-specific studies did not document the presence of threatened or endangered species. If threatened or endangered species are encountered during remedial activities in OU8, then requirements of the Act would be applicable.
Fish and Wildlife Coordination Act	16 USC § 661 et seq. 40 CFR § 6.302	No	Yes	Requires coordination with federal and state agencies to provide protection of fish and wildlife in water resource development programs; regulates actions that impound, divert, control, or modify any body of water. However, proposed remedial action activities in OU8 will not affect fish or wildlife. If it appears that remedial activities may impact wildlife resources, EPA will coordinate with both the U.S. Fish and Wildlife Service and the Colorado Department of Natural Resources.
Wilderness Act	16 USC 1311, 16 USC 668 50 CFR 53, 50 CFR 27	No	No	Limits activities within areas designated as wilderness areas or National Wildlife Refuge Systems.
Executive Order No. 11988 Floodplain Management	40 CFR § 6.302 & Appendix A	Yes	---	Pertains to floodplain management and construction and impoundments in such areas.
Executive Order No. 11990 Protection of Wetlands	40 CFR § 6.302(a) and Appendix A	Yes	---	Minimizes adverse impacts on areas designated as wetlands.
Section 404, Clean Water Act (CWA)	33 USC 1251 et seq 33 CFR Part 330	Yes	---	Regulates discharge of dredged or fill materials into waters of the United States. Substantive requirements of portions of Nationwide Permit No. 38 (General and Specific Conditions) are applicable to OU8 remedial activities conducted within waters of the United States.
The Historic and	16 USC 469	Yes	---	Establishes procedures to preserve historical and archeological data that

TABLE 8 (continued)
SUMMARY OF FEDERAL AND STATE LOCATION-SPECIFIC ARARS
OPERABLE UNIT 8
CALIFORNIA GULCH SUPERFUND SITE

Standard, Requirement, Criteria, or Limitation	Citation	Potentially Applicable	Potentially Relevant and Appropriate	Description
Archaeological Data Preservation Act of 1974	40 CFR § 6.301(c)			might be destroyed through alteration of terrain as a result of a federal construction project or a federally licensed activity program. A cultural resource survey was completed in OU8 to identify historic properties which may be affected by response activity.
National Historic Preservation Act (NHPA)	16 USC § 470 et seq 40 CFR § 6.301(b) 36 CFR Part 63, Part 65, Part 800	Yes	---	Expands historic preservation programs; requires preservation of resources included in or eligible for listing on the National Register for Historic Places. Although the Gaw brewery site is eligible, remedial activities in the vicinity will avoid the Site.
Executive Order 11593 Protection and Enhancement of the Cultural Environment	16 USC § 470	Yes	---	Directs federal agencies to institute procedures to ensure programs contribute to the preservation and enhancement of non-federally owned historic resources. Consultation with the Advisory Council oil Historic Preservation is required if response activities should threaten cultural resources.
Historic Sites Act of 1935	16 USC § 461-467	No	No	Preserves for public use historic sites, buildings, and objects of national significance.
The Archeological Resources Protection Act of 1979	16 USC §§ 470aa-47011	No	Yes	Requires a permit for any excavation or removal of archeological resources from public lands or Indian lands. May be relevant and appropriate if archeological resources are encountered during remedial action activity. Although the Gaw brewery site is eligible, remedial activities in the vicinity will avoid the Site.
Resource Conservation and Recovery Act (RCRA), Subtitle D	40 CFR Part 257, Subpart A, § 257.3-1 Floodplains, paragraph (a)	Yes	---	Provides general classification criteria for solid waste disposal facilities pertaining to floodplains.

TABLE 8 (continued)
SUMMARY OF FEDERAL AND STATE LOCATION-SPECIFIC ARARS
OPERABLE UNIT 8
CALIFORNIA GULCH SUPERFUND SITE

Standard, Requirement Criteria, or Limitation	Citation	Potentially Applicable	Potentially Relevant and Appropriate	Description
STATE OF COLORADO				
Nongame, Endangered or Threatened Species Act	CRS §§ 33-2-101 to 108	No	No	Standards for regulation of nongame wildlife and threatened and endangered species. Site-specific studies did not document the presence of threatened or endangered species. If threatened or endangered species are encountered during remedial activities in OU8, then requirements of Act will be applicable.
Colorado Register of Historic Places	CRS §§ 24-80.1-101 to 108	No	No	Authorizes the State Historical Society to nominate properties for inclusion on the State Register of Historic Places. Applicable only if remedial action activities impact an area listed on the Register.
Colorado Historical, Prehistorical, and Archaeological Resources Act	CRS §§ 24-80-401 to 410 1301 to 1305	No	Yes	Concerns historical, prehistorical, and archaeological resources; applies only to areas owned by the State or its political subdivisions. May be relevant and appropriate if remedial action impacts an archaeological site.
Colorado Species of Special Concern and Species of Undetermined Status	Colorado Division of Wildlife Administrative Directive E-1, 1985, modified	No	No	Protects species listed on the Colorado Division of Wildlife generated list. Urges coordination with the Division of Wildlife if wildlife species are to be impacted. No evidence of species of special concern have been identified at this site.
Colorado Natural Areas	Colorado Revised Statutes, Title 33 Article 33, Section 104	No	No	Maintains a list of plant species of “special concern.” Coordination with Division of Parks and Outdoor Recreation is recommended if activities will impact listed species. No “special concern” plant species have been identified but will comply if any are encountered.

TABLE 8 (continued)
SUMMARY OF FEDERAL AND STATE LOCATION-SPECIFIC ARARS
OPERABLE UNIT 8
CALIFORNIA GULCH SUPERFUND SITE

Standard, Requirement Criteria, or Limitation	Citation	Potentially Applicable	Potentially Relevant and Appropriate	Description
Colorado Solid Waste Disposal Sites and Facilities Act,	6 CCR 1007-2 6 CCR 1007-2, Part I	No	No	Establishes regulations for solid waste management facilities, including location standards. Proposed remedial action in OU8 will not establish a solid waste management facility.

TABLE 9
SUMMARY OF FEDERAL AND STATE ACTION-SPECIFIC ARARS
OPERABLE UNIT 8
CALIFORNIA GULCH SUPERFUND SITE

Standard, Requirement Criteria, or Limitation	Citation	Potentially Applicable	Potentially Relevant and Appropriate	Description
FEDERAL				
Solid Waste Disposal Act as amended by the Resource Conservation and Recovery Act of 1976 (RCRA)	40 CFR Part 257, Subpart A: § 257.3-1 Floodplains, paragraph (a); § 257.3-7 Air, paragraph (b)	Yes	–	Selected portions of Part 257 pertaining to floodplains and air are applicable. These provisions establish criteria for classification of solid waste disposal facilities and practices.
Hazardous Materials Transportation Act	49 USC § 1801-1813 49 CFR 107, 171-177	No	No	Regulates transportation of hazardous materials. Proposed remedial action in OU8 will be conducted on private property and will not entail off-site transportation of hazardous materials.
STATE OF COLORADO				
Colorado Solid Waste Disposal Sites and Facilities Act	6 CCR 1007-2	No	No	Establishes standards for licensing, locating, constructing and operating solid waste facilities. Proposed remedial action in OU8 will not involve establishment of a solid waste disposal facility.
Colorado Water Quality Control Act, Storm Water Discharge Regulations	5 CCR 1002-2	Yes	–	Establishes requirements for storm water discharges (except portions relating to Site-wide Surface and Groundwater). Substantive requirements for storm water discharges associated with construction activities are applicable.
Colorado Mined Land Reclamation Act	CRS 34-32-101 to 125 Rule 3 of Mineral Rules and Regulations	No	Yes	Regulates all aspects of land use for mining, including the location of mining operations and related reclamation activities and other environmental and socio-economic impacts.

TABLE 9 (continued)
SUMMARY OF FEDERAL AND STATE ACTION-SPECIFIC ARARS
OPERABLE UNIT 8
CALIFORNIA GULCH SUPERFUND SITE

Standard, Requirement Criteria, or Limitation	Citation	Potentially Applicable	Potentially Relevant and Appropriate	Description
Colorado Air Pollution Prevention and Control Act	5 CCR 1001-3; Sections III.D.1.b,c,d. Sections III.D.2.a,b,c,e,f,g. Regulation 1	Yes	–	Regulation No. 1 provisions concerning fugitive emissions for construction activities, storage and stockpiling activities, haul roads, haul trucks, and tailing piles are applicable (5 CCR 1001-3; Sections III.D.2.a,b,c,e,f,g.). Construction activities in OU8 will be conducted in accordance with a fugitive emissions control plan.
Colorado Noise Abatement Act	CRS §§ 25-12-101 to 108	Yes	–	Establishes maximum permissible noise levels for particular time periods and land use related to construction projects.
Regulations on the Collection of Aquatic Life	2 CCR 406-8, Ch. 13, Article III, Sec. 1316	No	No	Requirements governing the collection of wildlife for scientific purposes. Remedial action activities within OU8 will not include biological monitoring.
Colorado Hazardous Waste Regulations	6 CCR 1007-3, Part 264: Section 264.301, (g), (h), (i), and (j); Section 264.310, (a)(1) through (a)(4); Section 264.310, (b)(1) and (b)(5)	No	Yes	These specific provisions of the hazardous waste regulations may be relevant and appropriate depending on site-specific conditions in OU8. Specific provisions of Section 264.310 concern run-on control, run-off control, management of run-on and run-off control systems, and wind dispersal. Specific provisions of Section 264.310 concern placement of a cover to minimize infiltration, minimize maintenance, promote drainage and minimize erosion, and accommodate settling.
Colorado Air Pollution Prevention and Control Act	5 CCR 1001-4 Regulation 2 Odors	Yes	–	Applicable only if remedial action activities cause objectionable odors. Remedial action in OU8 is not expected to produce odors.
Colorado Air Pollution Prevention and Control Act	5 CCR 1001-5 Regulation 3 APENs	Yes	--	Substantive provisions of APENs will be met.

TABLE 10

DETAILED COST ESTIMATE
NON-RESIDENTIAL AREA SOILS ALTERNATE 2:
CONTAINMENT WITH REVEGETATION
OPERABLE UNIT 8
CALIFORNIA GULCH SUPERFUND SITE

DIRECT CAPITAL COSTS

Component	Unit	Total Quantity	Total Cost	
Recontour Surface				
Grade Surface	sq. yd.	9,682	$6,584	
Revegetation w/amend.				
Upland Areas	acres	1	$10,000	
Wetland Areas	acres	1	$10,000	
Dust Control	day	2	$400	
Sediment Control	ls	1	$3,000	
TOTAL DIRECT CAPITAL COSTS				**$29,984**
INDIRECT CAPITAL COSTS				
Engineering and design (10% of direct)			$2,998	
Contingency (25% of direct)			$7,496	
Legal Fee (5% of direct)			$1,499	
Regulatory Cost (5% of direct)			$1,499	
Mobilization and Demobilization (10%)			$2,998	
EPA fees (20% of engineering, 5% of direct			$2,099	
TOTAL INDIRECT CAPITAL COSTS				**$18,590**
TOTAL CAPITAL COSTS				**$48,574**

POST REMOVAL SITE CONTROL COST

Discount 7.0%

Component	Unit	Each	Each/yr	$/year	Years	Present Worth
DIRECT OPERATION AND MAINTENANCE COSTS						
Inspection	hour	8	4	$1,280	30	$15,884
Vegetation Monitoring	acre	2	1	$2,000	5	$8,200
Erosion Repairs	acre	2	1	$400	30	$4,964
Vegetation Maintenance	acre	2	1	$800	30	$9,927
TOTAL				$4,480		$38,975
INDIRECT OPERATION AND MAINTENANCE COSTS						
Administration (5% direct)	lump	1	1	$224	30	$2,780
Misc. fees (5% of direct	lump	1	1	$224	30	$2,780
Reserve (25% of direct)	lump	1	1	$1,120	30	$13,898
TOTAL						**$19,457**

OPERATION AND MAINTENANCE PRESENT WORTH (30 YEARS) **$58,432**

GRAND TOTAL **$107,006**

TABLE 11

DETAILED COST ESTIMATE
FLUVIAL TAILING SITES ALTERNATIVE 2:
CONTAINMENT
OPERABLE UNIT 8
CALIFORNIA GULCH SUPERFUND SITE

DIRECT CAPITAL COSTS

Component	Unit	Total Quantity	Total Cost		
Recontour Surface					
Grade Surface	sq. yd.	120,265	$81,780		
Direct Revegetation					
Fair Wetland Area	acres	9.61	$96,100		
Poor Wetland Area	acres	1.94	$24,250		
Fair Upland Area	acres	11.77	$117,700		
Limestone	tons	1,109	$33,264		
Ripping and Grading	sq. yd.	56,979	$93,445		
Poor Upland Area	acres	1.52	$19,038		
Limestone	tons	98	$2,933		
Ripping and Grading	sq. yd.	7,373	$12,091		
Stabilize Banks in California Gulch - FTS-1, FTS-2 and part of FTS-8					
Cut & Fill Tailing	cu. yd.	2,580	$9,159		
Filter Fabric	sq. ft.	46,500	$5,580		
Riprap	ton	3,100	$95,325		
Dust Control	day	20	$4,000		
Sediment Control	site	5	$15,000		
TOTAL DIRECT CAPITAL COSTS				**$609,665**	
INDIRECT CAPITAL COSTS					
Engineering and design (10% of direct)			$60,967		
Contingency (25% of direct)			$152,416		
Legal Fee (5% of direct)			$30,483		
Regulatory Cost (5% of direct)			$30,483		
Mobilization and Demobilization (10%)			$60,967		
EPA fees (20% of engineering, 5% of direct)			$42,677		
TOTAL INDIRECT CAPITAL COSTS				**$377,992**	
TOTAL CAPITAL COSTS				**$987,657**	

POST REMOVAL SITE CONTROL COST

Discount 7.0%

Component	Unit	Each	Each/yr	$/year	Years	Present Worth	
DIRECT OPERATION AND MAINTENANCE COSTS							
Inspection	hour	8	4	$1,280	30	$15,884	
Vegetation Monitoring	acre	25	1	$24,843	5	$101,861	
Erosion Repairs	acre	25	1	$4,969	30	$61,656	
Vegetation Maintenance	acre	25	1	$12,422	30	$154,139	
TOTAL				$43,513		$333,539	
INDIRECT OPERATION AND MAINTENANCE COSTS							
Administration (5% direct)	lump	1	1	$2,176	30	$26,998	
Misc. fees (5% of direct)	lump	1	1	$2,176	30	$26,998	
Reserve (25% of direct)	lump	1	1	$10,878	30	$134,989	
TOTAL						$188,985	
							$522,524

OPERATION AND MAINTENANCE PRESENT WORTH (30 YEARS)

GRAND TOTAL **$1,510,181**

TABLE 12

DETAILED COST ESTIMATE
STREAM SEDIMENT ALTERNATIVE 2:
REMOVAL AND RECONSTRUCTION IN FTS3 AND FTS 6
OPERABLE UNIT 8
CALIFORNIA GULCH SUPERFUND SITE

DIRECT CAPITAL COSTS

Component	Unit	Total Quantity	Total Cost	
Channel Reconstruction - FTS-3				
500-yr Channel				
Channel Excavation	cu. yd	1,325	$26,500	
Channel Grading	sq. yd	2,139	$1,454	
Filter Fabric	sq. ft.	19,250	$2,310	
Riprap for Channel	ton	2,235	$68,726	
Pilot Channel				
Channel Excavation	cu. yd.	1.056	$21,120	
Channel Grading	sq. yd.	1,583	$1,077	
Filter Fabric	sq. ft.	14,250	$1,710	
Riprap for Channel	ton	1,030	$31,673	
Enkamat	sq. ft.	28,500	$28,500	
Revegetate Overbank	acre	1.1	$13,631	
Erosion Control Matting	sq. yd.	15,200	$30,400	
Channel Reconstruction - FTS-6				
Channel Excavation	cu. yd.	1,630	$32,593	
Channel Grading	sq. yd.	2,778	$1,889	
Filter Fabric	sq. ft.	30,000	$3,600	
Concrete Blocks	sq. ft.	25,000	$125,000	
Repair Berm (Ski Club)				
Regrading	sq. yd.	2333	$1,587	
Build Berm	cu. yd.	650	$4,875	
Filter Fabric	sq. ft.	10,500	$1,260	
Riprap Berm	ton	350	$10,763	
Repair Berm (AV Slag)				
Regrading	sq. yd	1,778	$1,209	
Build Berm	cu. yd.	560	$4,200	
Filter Fabric	sq. ft.	15,000	$1,800	
Riprap Berm	ton	500	$15,375	
Dust Control	day	20	$4,000	
Sediment Control	ls	1	$3,500	
TOTAL DIRECT CAPITAL COSTS				**$438,750**
INDIRECT CAPITAL COSTS				
Engineering and design (10% of direct)			$43,875	
Contingency (25% of direct)			$109,688	
Legal Fee (5% of direct)			$21,938	
Regulatory Cost (5% of direct)			$21,938	
Mobilization and Demobilization (10%)			$43,875	
EPA fees (20% of engineering, 5% of direct)			$30,713	
TOTAL INDIRECT CAPITAL COSTS				**$272,027**
TOTAL CAPITAL COSTS				**$710,777**

POST REMOVAL SITE CONTROL COST

Discount 7.0%

Component	Unit	Each	Each/yr	$/year	Years	Present Worth
DIRECT OPERATION AND MAINTENANCE COSTS						
Inspection	hour	8	4	$1,280	30	$15,884
Vegetation Monitoring	acre	1.1	1	$1,090	5	$4,471
Erosion Repairs	lf	2500	1	$2,500	30	$31,023
Vegetation Maintenance	acre	1.1	1	$545	30	$6,766
TOTAL				$5,416		$58,143
INDIRECT OPERATION AND MAINTENANCE COSTS						
Administration (5% direct)	lump	1	1	$271	30	$3,360
Misc. fees (5% of direct)	lump	1	1	$271	30	$3,360
Reserve (25% of direct)	lump	1	1	$1,354	30	$16,801
TOTAL						$23,521
OPERATION AND MAINTENANCE PRESENT WORTH (30 YEARS)						**$81,664**
				GRAND TOTAL		**$792,441**